"When we pretend to limit the operations of nature, to suit our contracted ideas, we most probably do her injustice."

WILLIAM McLURE (1818)

8

DEPOSITIONAL HISTORY AND ENVIRONMENT

CHAPTER 8
DEPOSITIONAL HISTORY AND ENVIRONMENT

GENERAL

Synthesizing the field observations and laboratory data, presented so far in the foregoing chapters, it is here attempted to bring out and discuss various factors and parameters that controlled the overall, sedimentation history and environment of deposition of the Lower Gondwana Group of rocks of Pranhita-Godavari (P.G.) basin. Lithologically the Lower Gondwana Group of P. G. Basin can be divided into two distinct divisions - 1) Diamictite and shale dominated Talchir deposits and 2) Sandstone dominated post-Talchir deposits which include Barakar, Barren Measures and Kamthi Formations. In this present chapter the following aspects are discussed.

- Depositional environments of Talchir Diamictites and Shale.
- Depositional history and environment of Post-Talchir Lower Gondwana sands and coal environments.
- Tectonic control on Lower Gondwana sedimentation
- Channel pattern and sedimentation

TALCHIR FORMATION

Around Bellampalli area, the diamictites of Talchir Formation occur at two stratigraphic horizons, separated by an association of sandstones, interbedded siltstones and shales in ascending order. Such facies association corresponds to a typical section in a continental glacial deposits (Eyles et. al. 1983; Eyles and Miall, 1984). The two units of diamictites grain size distributions are inferred to represent sub-glacially formed massive tillites while the intervening sandstones, siltstones and shales were deposited during warmer interglacial times.

The upper part of the basal diamictite unit, showing crude stratification and containing pockets of sandstones, is considered to represent what is termed as "meltout till" formed by melting and partial reworking of the basal sub-glacial "lodgement till" (Einsele, 1992). Development of crude, parallel lamination and somewhat parallel allignment of rounded pebbles suggest that these sediments were deposited by meltwater in outwash plains of a glacio-fluvial environment (Augistinus and Reizbos, 1971). The overlying sandstone unit, which is poorly exposed in the study area, is envisaged to be deposited in a lake delta setting of distal lakes by avalanching high energy meltwater streams underflowing the standing lake water and gravity movements. Such a deposit has been described in chapter 5 as an undaturbidite deposits, whose transport is intermediate between normal tractive and turbidity current. The siltstone and shale units were deposited by meltwater in more proximal part of tranquil glacio-lacustrine conditions during the initial stages of deglaciation (Antevs, 1951; Smith and Ashley, 1985).

The overlying younger diamictite unit, similar in lithology to the basal massive diamictite represents the second phase of glaciation in this part of the basin. The pattern of assemblage of other sedimentary units above the younger diamictite unit is succeeded by silt-shale intercalation and sandstones. The variation in the assemblages is attributed to difference in the rate of deglaciation of the ice-front. The younger sandstone unit, (occurring at the top of Talchir sequence) formed by deposition of meltwater streams and displaying characteristics of fluvial deposits is a transitional one, marking the end of Talchir glaciation and beginning of fluvial Barakar sedimentation.

The origin of diamictite in the Talchir Formation is somewhat controversial one. In recent years, scepticism has been expressed about the glacial derivation of the diamictite. According to Raiverman (1985), shales, sandstones and diamictites of Talchir Formation were deposited in a marine milieau, the diamictites being of mudflow origin. Tilloids (note tillite), deposited as sub-marine mudflow, occur in association with deep marine turbidites (Pettijohn, 1984) which (latter) has not been encountered in the study area. Deposits resembling turbidites within the Talchir Formation, however, have been reported by Bose and Ramanamurthy (1979) from the Wardha-Penganga area, in the extreme N-W of the basin. But here the Talchir also contains 3.5 metres of varve coupletes of clay and siltstone with a number of pebble-sized erratics embedded in them (Bose and Ramanamurthy, op.cited). Although deposits resembling varve may be present in deep marine condition, presence of pebbles (dropstones) within them provide the strongest evidence of glaciation (Lindsay, 1969; Pettijohn, 1984). Similar association of ideal (Bouma) turbidites and dropstone bearing argillites have been reported from

Talchir Formation of Talchir (De, 1971) and Daltongunj basins (Datta et.al., 1979) and they have suggested that the influx of fluvio-glacial meltwater during periods of abnormal thawing, coupled with overloading of sediments at basin margin and consequent slumping were the factors responsible for the formation of turbidites in a glacio-lacustrine conditions.

The glacial origin (Smith, 1963) of the, striations on Pakhal limestones and shales at Irai in north P-G basin has been refuted by Raiverman et. al. (1985). Absence of striations on the "hard surface of quartzites and crystalline rocks which are more competent to retain the striations" in other parts of the basin was cited by them as the prime reason against the glacial theory. According to them the striations on limestones and shales are due to "exhumed tropical weathering" and "penecontenporaneous current scours".

The mere absence or presence of striations cannot be taken as a criterion in postulating the prevalence of glacial environment. Rather, the nature of the striations in conjunction with other parameters is more important. The various descriptions of the striations (e.g. crecentric mark, ice plucking) given by Smith (1963) conclusively point to the features of glacial origin. And secondly, if according to Raiverman et. al. (1985), the striations are due to exhumed tropical weathering, the question that arises is that why similar process could not produce such features on Pakhal limestones in other parts of the basin?

Besides sub-aqueous mud flow, sub-aerial or sub-aqueous landslides and solifluction (mass movement) can also produce deposits resembling glacial diamictite (tillite). But, for diamictites, subaerial or sub-aqueous mass flow processes are unlikely processes of transportation and deposition because (1) sub-areal tilloids related to land-slide, solifluction etc. are local or restricted in character (Dott, 1964; Pettijohn, 1984) whereas the Talchir diamictites show a wide areal distribution across the Indian peninsula for a length of 2000 km without any striking change in lithology and size gradation of embedded clasts (Casshyap and Qidwai, 1974) and (2) inverse grading which characterizes debris flow or grain flow deposits (Fisher, 1971; Lowe, 1976; Postma et. al., 1988) occurs neither in the study area nor in other parts of the basin (Bose and Ramanamurthy, 1979; Soman and Kale, 1993).

MARINE INFLUENCE

Although Raiverman et. al. (1985) mentioned that Talchir sediments in P. G. basin were deposited in a transgressive epicontinental sea, spread extensively over the peneplained shield, absence of any Talchir outcrops outside the limits of longitudinal basin boundary faults rules out the same. Deglaciation and subsequent isostatic readjustment might have resulted in an eustatic sea level rise (Ghosh and Bandyopadhyay, 1967) leading to the inundation of sporadic low-lying areas of the basin, as evidenced by the reported occurrence (Rawat and Jain, 1985) of marine *Leisospherids* and associated palynoflora in Talchir shales from various parts of the basin (cited in Raiverman et. al., 1985). But the inundation was not as extensive as in Pench valley coalfield in Satpura Basin (Casshyap and Qidwai, 1974), Sohagpur, Manendragarh and Umaria in Son valley (Ghosh and Bandyopadhyay, 1967) and Daltongunj in Koel valley (Datta et. al., 1979). These regions were lying in a higher latitudinal and longitudinal areas and were nearer to the shore line than the present day Gondwana deposits of Godavari basin (Fig. 8.1). Presence of unmistakable marine fauna (as in Umaria and Manendragarh) or lagoonal black shale-marl association (as in Daltongunj), which provide clear-cut evidence of marine influence have nowhere been found in the study area or reported from other areas in P. G. basin. According to the present author, the extreme northwestern extension of the basin, possibly representing the river mouth, now lying beneath the Deccan Trap, might have experienced large scale marine transgression during the interglacial periods of Talchir sedimentation.

Various lithologic, sedimentary, stratigraphic and palaeogeographic features discussed in the above paragraphs thus provide evidence that is strongly suggestive of glacial origin of Talchir sediments. Present day occurrence of Talchir rocks indicate that unsorted diamictite occurring at the base of the formation might have been laid down as ground moraiunes by different lobes of valley glaciers, rather than by a continuous ice sheet in the embryonic depression of the basement around individual basement prominences. The sediments overlying the basal tillite may be classed as periglacial deposits, laid down by glacial meltwater. Variation in glaciation and deglaciation by various ice-fronts account for the variability in thickness and nature of sediment association (except basal tillite) in Talchir section in different parts of the basin in general. Palaeogeographic reconstruction of

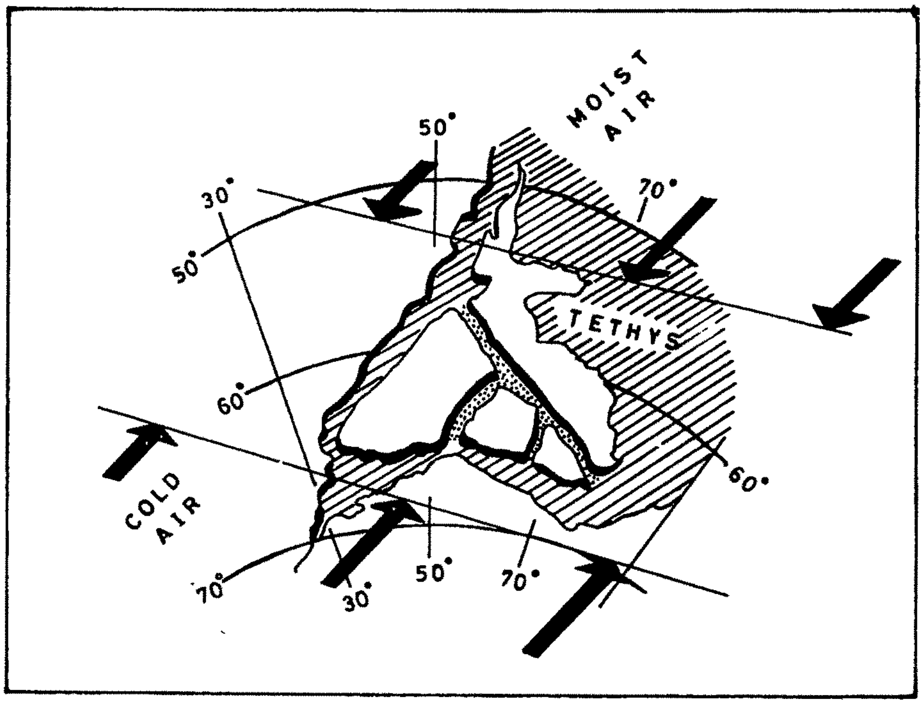


Fig. 8.1 : Palaeogeographic positions of India and Tethys during Talchir sedimentation.

(After De, 1996)

Gondwanaland during late Carboniferous and early Permian shows that the east coast of India lay in close juxtaposition with Enderbyland and Amery ice shelf area of East Antarctica (Dietz et. al., 1972; Crowell, 1979). North to north-east migration of ice-fronts in P. G. valley appears to be in harmony with northerly pattern of ice radiation (Crowell, 1979) from the polar regions of Antarctica, although the Antarctica landmass was definitely not the source of glacial sediments (Mitra et. al., 1979).

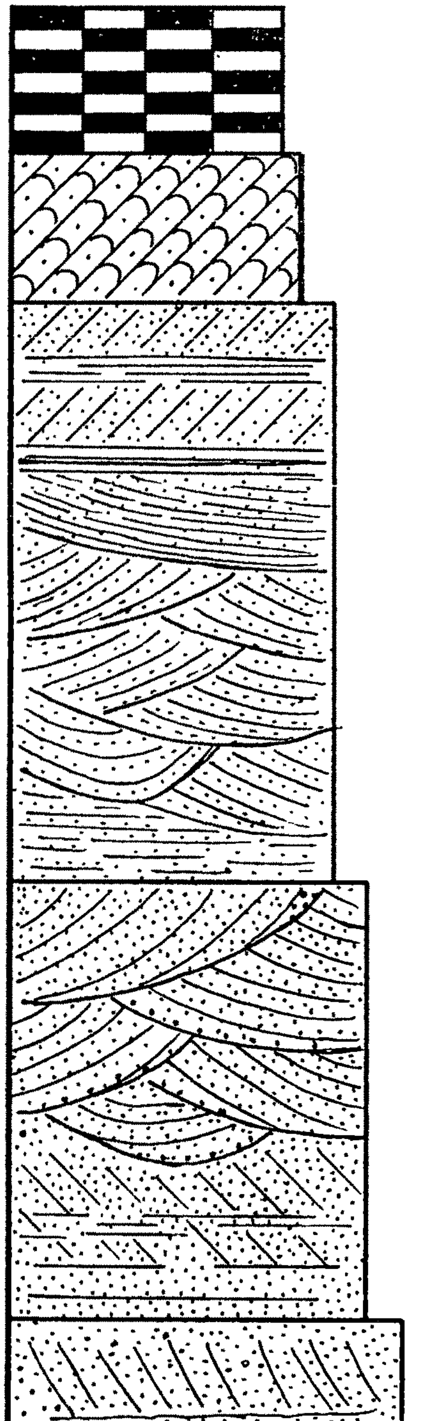
POST - TALCHIR LOWER GONDWANA DEPOSITS

The field characters, lithologs, petrography, various structural and textural features of post-Talchir Lower Gondwana deposits, described in the previous chapters, point to a dominantly fluvial transport and environment of deposition for these deposits. With amelioration in climate, the post-Talchir sedimentation started by melting and coalescence of more restricted glacio-fluvial models of Talchir. According to Chakrabarti and Chakrabarti (1996) the increase of temparature that was, to some extent responsible for the melting of ice, took place due to (a) increase in the solar energy influx to the earth and (b) mantle related heat emission along deep crustal rupture zones as a sequel to lithospheric distension.

Presence of pebbly, coarse-grained sandstones with abundant fresh feldspars and near absence of coal seams and shales in the lower part (100-120 metres) of the Barakar Formation (Fig. 4.2) point to the existence of rugged source land topography and steep depositional slope at the onset of Barakar sedimentation. These were the sites of high velocity braided streams, which with continued sedimentation and gradual maturation of source land topography, gave way to moderately sinuous anabranching fluvial system during the Middle and Upper Barakar times. With no major tectonic episode, except minor tilting of the basin floor, taking place, maturation of relief and reduction of depositional slope seems to have continued throughout the Barren Measures and Lower and Middle Kamthi times. Due to paucity of extensive outcrop, it is not possible to determine precisely the channel geometry during various stages of Lower Gondwana time. However, from the progressive increase in amount of finer clastics in Barren Measures, it becomes evident that the stream power became more and more sluggish with sedimentation. This resulted in an increase in sinuosity with a broadening or expansion of the depositional regime (Schumm, 1981, 1985; Galloway and Hobday, 1983).

The Lower Gondwana deposits of the study area may be regarded as by-product of various sub-environments of an alluvial plain (Fig. 8.2). Thick beds of coarse to medium and medium to fine grained sandstones (which form major portion of Barakar, Barren Measures Formation and Lower Kamthi Member) with profuse cross stratification (trough and planer) and horizontal lamination were deposited as channel (braid-,side-, or point-bar) deposits of a laterally accreting moderate to highly sinuous, an a branching (multi-channel) streams during high and low velocity stages respectively (Allen, 1965; Jackson, 1976; Cant and Walker, 1976; Kirk, 1983). The fine grained facies (represented by siltstone-shale intercalation and shale) which shows gradual transition into the underlying coarse grained facies represent level deposits, formed by lateral accretion of the channel while those underlain abruptly by coarse or medium grained sandstones are considered to be overbank deposits, formed by vertical accretion during overbank flooding (Bridge, 1984; Nanson, 1986).

High percentage of thick clay and shale beds alternating with sandstone beds represent laterally accreted distal floodplain deposits of a laterally active single channeled river characterized by wide expanse and low gradient (Jackson, 1981; Nanson, 1980). Thin beds of sandstone within the shale and clay units in the upper part of the Middle Member represent crevasse splay deposits during high-water stages (Galloway and Hobday, 1983; Bridge, 1984) indicating sudden changes in precipitation regimes (Rust, 1981) in a semi-arid climate. Development of calcareous nodules in the red and green shales in the upper part of the Middle Kamthi Member (mentioned earlier) is a typical feature of paleosol of an arid flood-basin complex (Leeder, 1975; Hubert, 1978). Similar calcic floodplain paleosol has been reported by Smith (1995) from the Permo-Triassic transition sequence in Karoo Gondwana basin in South Africa. Carbonaceous shales and siltstones in Barakar, Barren Measures Formation and Lower Kamthi Member represent backswamp deposits under a very low flow regime through slow settling of silt, clay and vegetal debris through relatively calm waters.



Observations	Environment
Coal / Carbonaceous shale	Back swamp deposits with vegetal accumulation.
Sand silt clay intercalation with ripple drift and wavy lamination	Laterally accreted distal flood plain deposits/overbank deposits formed by vertical accretion.
Fine to medium grained sandstones with tabular and trough crossbedding. Horizontal bedding occuring at intervals.	Lateral accretion deposits during lower velocity stages.
Medium to coarse grained sandstones with ubiquitous trough and occassional tabular crossbedding.	Channel deposits formed by lateral accretion of braid-, side- or point-bar deposits.
Very coarse grained pebbly sandstones with occassional crossbedding.	Channel deposits probably formed by lateral accretion of transverse bars within channel course.

Fig. 8.2 : Idealised standard fining upward fluvial cycles for post-Talchir Lower Gondwana deposits, as deduced from surface and borewell studies.

COAL-FORMING ENVIRONMENT

The coal forming environment, whether a lake or swampy marsh is generally not a normal feature of alluvial flood plains (Strahler, 1983; Nadon, 1994) because, one of the main prerequisites for coal formation is an area isolated from clastic input (Mc Cabe, 1984). Thus, the occurrence of coal in Barakar Formation and Lower Kamthi Member which are essentially sand-dominated units, can be attributed to deposition of vegetal debris in impounded bodies of stagnant water formed by selective differential subsidence of the basin floor (Khan and Tewari, 1991; Krischbaum and Mc Cabe, 1992). Variability in thickness of different coal seams indicates variation in availability of vegetal material as well as existence of duration of swamp conditions, the latter depending on fresh input of clastic detritus which can be brought about by periodic flooding caused by major drainage switch (Duff. et. al., 1967). Variability in lateral extent of the coal seams, on the other hand, can be attributed to the areal extent of the swamp conditions formed by the bodies of stagnant water. Splitting of these coal seams indicate that while swamp conditions were prevelant in one place alluviation of sand, silt or mud was operative in other areas.

Origin of Indian Gondwana coal is debatable. Most workers (e.g. Fox, 1931, 1934; Pascoe, 1959) postulated drift theory and argued that coal substance originated from vegetal debris that was transported from the forest clad catchment areas. Ahmed (1961) and Niyogi (1966) have expressed opinions in support of in-situ origin. Presence of uprooted stems or tree trunks on the roof of coal seams, which strongly gives evidence for insitu origin have not yet been reported from the coal seams of Godavari valley. On the other hand, it is quite reasonable to believe that large quantities of vegetation cannot be carried by streams into coal swamps which witnessed a more or less stagnant condition. The hydraulic regime of a stream carrying vegetal debris from catchment areas and debouching them into impounded lakes had to be strong enough to scour any thin coal seam formed in those places.

Thus the balance of evidence favours a hypautocthonous origin of coal as postulated by Ghosh (1975). It can thus be stated that the vegetal matter was subjected to little churning action in their general area of growth during the start of the coal forming environment. With the acceleration of vegetal growth in swamp and marshes, ideal coal forming conditions prevailed. During the luxurious growth of plants, some drifting vegetation might have entered the swamp through slow flowing streams. But such drifted vegetation probably contributed to the coal formation in the peripheral part of the swamp and not in the main part.

Absence of coal in Barren Measures Formation reflects the prevalence of arid, climatic conditions, unfavourable for the luxurious growth of plants and subsequent preservation of vegetal and organic matter. Presence of thin layers of carbonaceous shale and kaolinitic matrix within the Barren Measures sandstones, however, indicate intermittent short-lived periods of humidity during which time scanty growth and preservation of vegetal matter took place in restricted backwater conditions.

TECTONIC CONTROL ON SEDIMENTATION

The beginning and end of Lower Gondwana sedimentation in Pranhita-Godavari basin were marked by two major tectonic episodes which correspond to the third and fourth stage of rifting (block faulting) of a four-stage rift cycle that was responsible for the evolution of the P. G. basin (Srinivasa Rao, K, et. al., 1979; Ramanamurthy and Parthasarathy, 1988; Ramanamurthy, 1996) (For details please refer Ch-1).

Pattern of disposition and lithologic characters of various Lower Gondwana rock units indicate that there was no such major tectonic impulses during the course of the sedimentation. Fairly constant proportions of detrital mineralogy in all Lower Gondwana Formation point to the absence of any tectonism in the source area. Present day occurrences of younger Gondwana Formations in the successively more eastern part of the basin indicate that the fluvial system, while maintaining a NNW direction, bodily shifted laterally to the east with time within the basin of deposition (Sengupta, 1970). The lateral shift of the fluvial system was due to northeasterly tilt of the basin floor, which was brought about by slow syn-sedimentary faulting along the eastern margin of the basin (Sengupta, op. cited). The faulting became more pronounced during the closing stages of Lower Gondwana sedimentation resulting in a very fast rate of basinal susbsidence, as reflected in the enormous thickness of 750 m. of finer clastics of the Middle Kamthi Member. Closeness of the contours along the eastern margin of the Bouger anomaly map of the basin, prepared by

Mishra et. al. (1987) is indicative of the steep gradient of the eastern margin of the basin which indeed suggests a north-easterly tilting of the basin floor, resulting in the present day half graben structure.

Presence of successive fining upward cycles (sandstone → siltstone → Shale → Coal) within the post-Talchir Lower Gondwana rocks of the P. G. basin can be attributed to the lateral migration of channels in a slowly subsiding regime (Majumdar et al., press). The nature and thickness of the cycles, however, vary within a single formation and from one to another. The variation in nature (complete or truncated) of the cycles was caused by variation in channel morphology and stream hydraulics while the difference in their thickness was controlled by differential and selective subsidence of the basin floor. Truncated fining upward cycles which are more common in Lower Barakar and Barren Measures Formations suggest recurring channel establishment and abandonment due to sudden, rapid discharge. During the deposition of Lower part of Barakar Formation, a youthful topography, implying substantial difference in relief between provenance and depositional areas was responsible for rapid and sudden swift of the channels. Sediments belonging to Barren Measures Formation and Lower Kamthi Member were deposited in a semi-arid to arid climate when intermittent, sudden high precipitation causing flash floods of high magnitude (Olsen and Larsen, 1993; Reid, 1994) might have entered the areas of abandoned channels and flood plains, thereby distrubing the cyclic pattern of deposition. A more regular or complete cycle implies a gradual encroachment of swamps and floodplains by adjacent levee and channel environments as a consequence of slow and gradual lateral shift of channel coarses across the alluvial plain.

Synsedimentational intrabasinal faulting of different behaviour, distributed in time and space during the Lower Gondwana time was responsible for the selective and differential subsidence of the basin. The faulting might have been caused by either 1) reactivation of weak zones in the basement or 2) volume shrinkage in sediments due to differential compaction in the coarse of progressive compaction and lithification (Laskar, 1979; De, 1979a). The loci of maximum sagging become the locale of maximum clastic accumulations as well as centres of widespread levee and swampy conditions. Figure 8.3 depicting lower surface of Barren Measures Formation, largely inherited from bottom topography, at the time of its deposition at various parts of the study area can

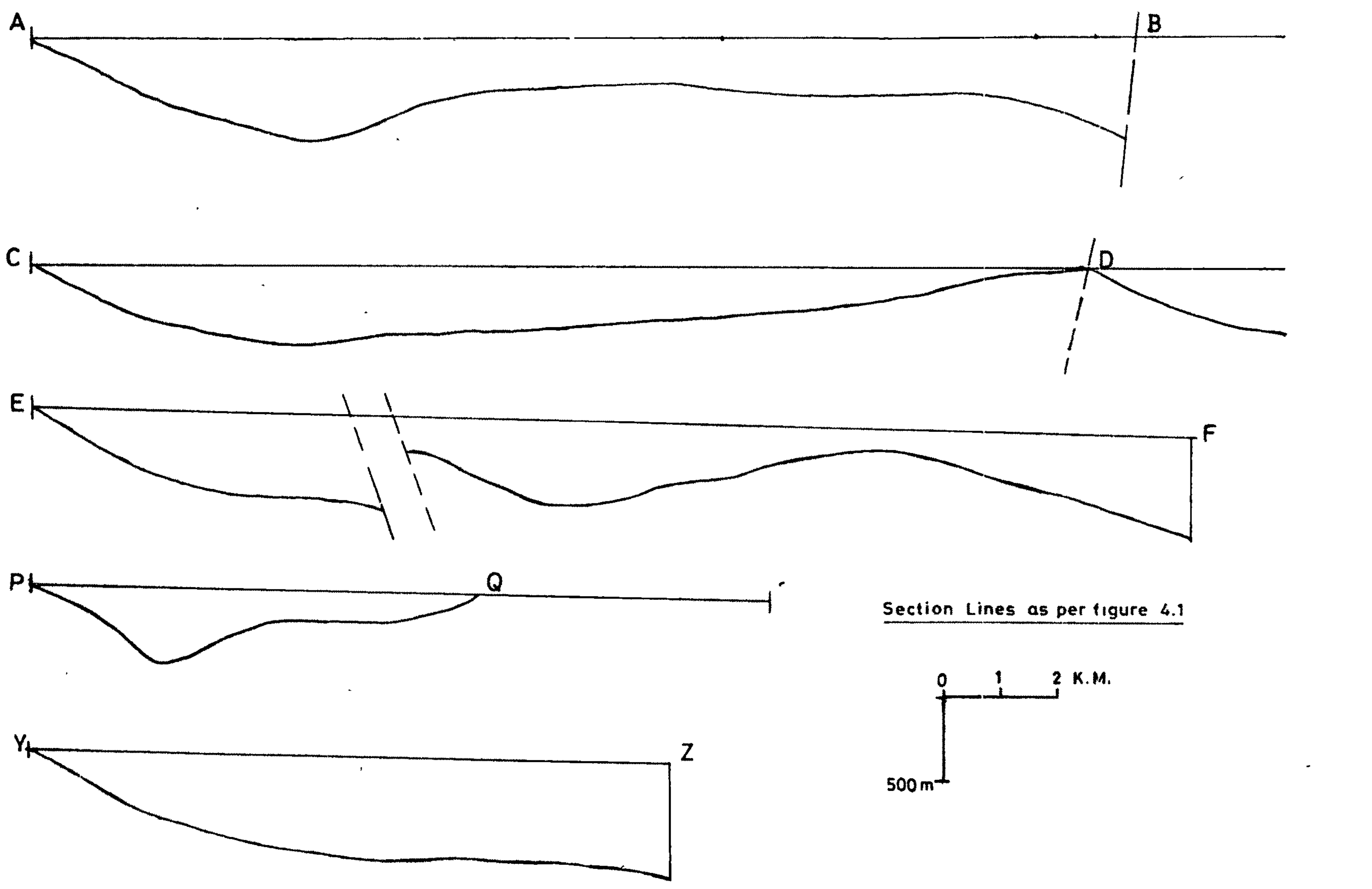


Fig. 8.3: Net thickness of Barren Measures Formation across various sections of the study area.

be cited as an example to demonstrate the importance of basin floor undulations in controlling subsidence and hence sedimentation pattern of Lower Gondwana sediments. It is thus clear that the sedimentary cycle forming processes within the Lower Gondwana Formations was controlled by purely local factors such as subsidence and sedimentation and hence these fluvial cycles fall into "autocyclic" category of Beerbower (1964).

The variations in the loci of subsidence have been primarily responsible for progressive shifting of the basin axis and redefining the domain of sedimentation. The triangle-ratio facies map of Barakar Formation (above Salarjung seam or its equivalent) (Fig. 8.4) around Bellampalli demonstrates the complex interfringing of various subenvironments of wandering river channels. Sub-parallel relationship between the isopach strike of Barren Measures (Fig. 8.5) and facies strike of Barakar Formations indicates that the Lower Gondwana sedimentation in the study area took place in a concurrently but slowly subsiding basin (Krumbein, 1952).

CHANNEL PATTERN VIS-A-VIS SEDIMENTATION

During the Lower Gondwana sedimentation in Pranhita-Godavari basin, maturation of source-land topography due to amelioration of climate and north-easterly tilting and differential subsidence of the basin floor are considered to be main factors which played major part in controlling the evolution of channel pattern from a braided fluvial system during the Lower Barakar to a meandering one during the Middle Kamthi time. During the intervening Middle-Upper Barakar, Barren Measures and Lower Kamthi time, the channel pattern was 'anabranching' type which can be defined as a multichannel system, separated by interchannel areas whose width is three times or more than the channel width (Schumm, 1985). Within such a fluvial system, individual channels may meander, braid or be relatively straight (Schumm, Op. cited). With increased sedimentation and reduction in slope there was an overall increase in sinuosity of these anabranching channels.

Evolution of a multichannel system can be attributed to (i) avulsion (erosion) based process and (ii) accretion based process (Nanson and Knighton, 1996). Indeed, such processes were in operation during the Lower Gondwana sedimentation, as reflected in the haphazard, truncated cyclicity

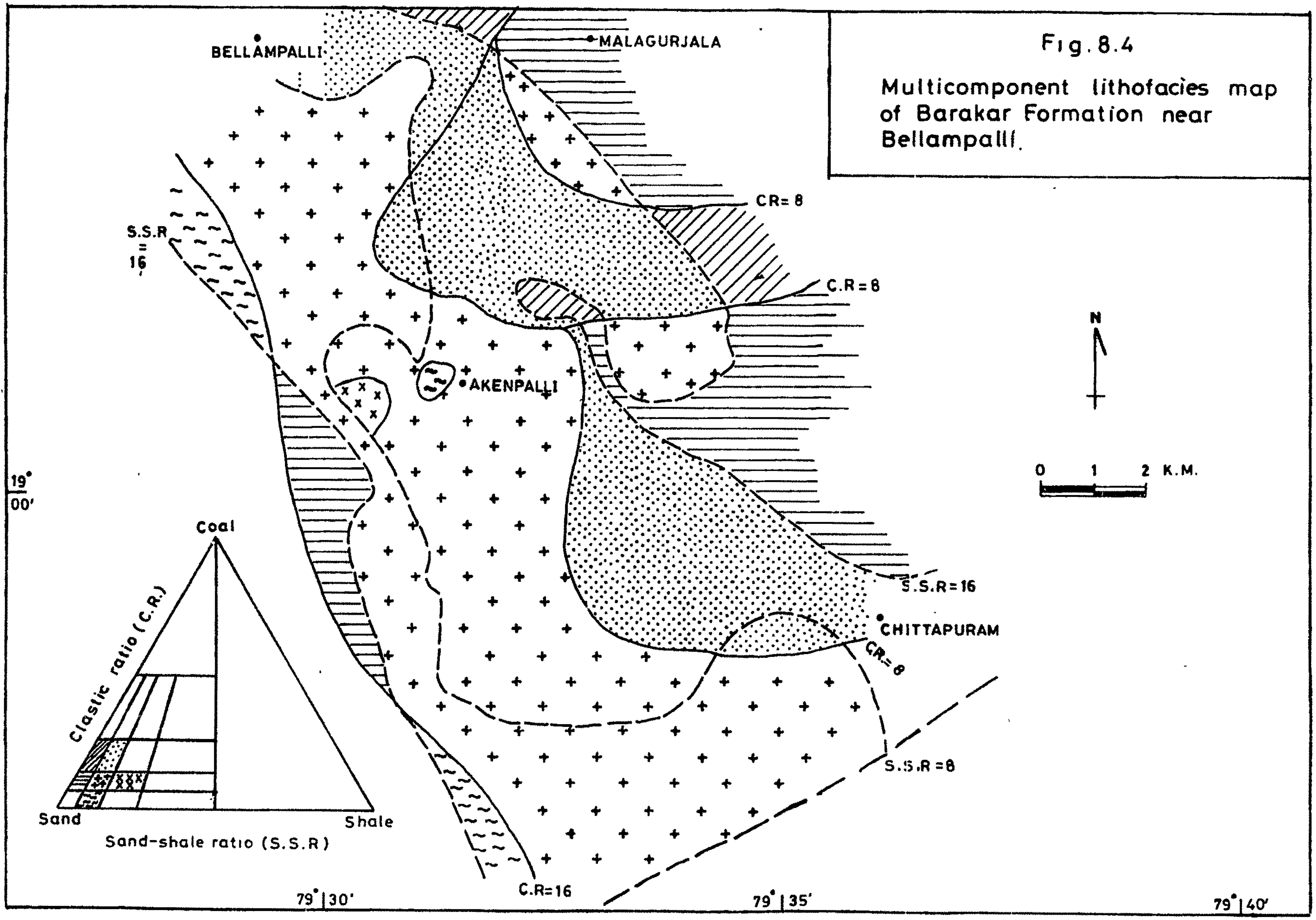


Fig. 8.4
Multicomponent lithofacies map of Barakar Formation near Bellampalli.

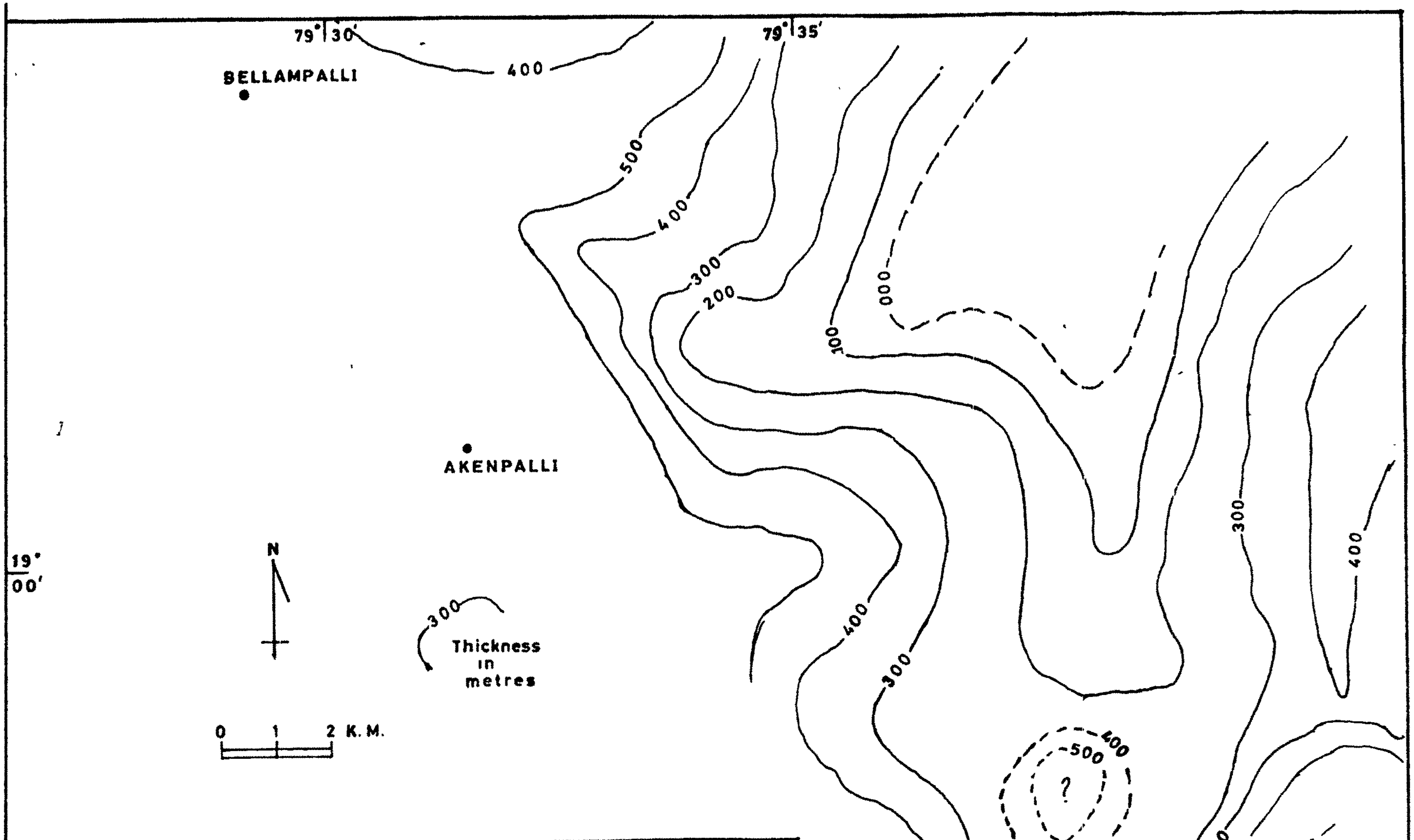


Fig.8.5: Isopach map of Barren Measures Formation near Bellampalli.

exhibited by various units deposited by lateral and/or vertical accretion. The tilting of the basin floor and consequent greater subsidence led to an overall sinuosity of these anabranching channels.

Evolution of a meandering river during the Middle Kamthi time can be regarded, on a large scale, as a part of the 4-stage conceptual model of Smith et. al. (1989) which shows that increase in aggradation of flood plain and reduction in the formation of new incised channels may lead to the concentration of flow being confined into few main channels which after cessation of aggradation may coalesce into a single channel of dominantly meandering habit. Dominance of fine-grained over bank deposits, characterized by low gradient flood plains within the Middle Kamthi Member can be regarded as a criterion in inferring a continuum in alluvial environment (Nanson, 1986) ranging from and characterized by coarse-grained traction load Lower Barakar facies to fine grained Middle Kamthi facies. In other words, the sedimentation during Lower Gondwana time was essentially uninterrupted or continuous.

It is essential here, to analyse and understand the term 'anastomosing', which is frequently used to describe channel pattern intermediate between braided and meandering. Anastomosing channels are fine-grained, low energy, multichannel system of relatively uniform and narrow width with low gradient and stable banks (Smith and Putnam, 1980; Smith, 1983; Knighton and Nanson, 1993; Nanson and Knighton, 1996). On the other hand the term anastomosing has also been used to define coarse-grained, high energy, multichannel systems with low sinuosity (Mollard, 1973; Casshyap and Tiwari, 1984; Stanistreet and McCarthy, 1993), while, Church (1983) used the term for gravel river bed. Confusion, thus, prevails regarding the term "anastomosing". Recent works on facies modelling of anastomosed rivers by various workers (Smith and Smith, 1980; Smith, 1986; Tornqvist, 1993; Nadon, 1994) define anastomosed rivers as fine grained, laterally stable low-energy system and recognize deposits of such river system to be composed predominantly of shale, siltstone and clays (representing overbank and level deposits) with lenticular or stringer like bodies of medium to coarse sandstone (representing channel deposits). As per the above criteria of distribution of facies, fluvial deposits of Barakar and Barren Measures Formations do not conform to the anastomosing facies model since these deposits are essentially sand units with subordinate shale, clay and/or coal bands. Moreover during the Lower Gondwana sedimentation, there was a progressive lateral shift of the channel system, a factor or criteria which is rarely found or is absent in anastomosing rivers which are generally agreed to have fine-grained, cohesive, stable banks with individual channels showing little tendency to migrate (Smith and Putnam, 1980; Knighton and Nanson, 1993).

The anastomosing facies model proposed by Ramanamurthy (1985 & 1996) for Barakar Formation and Lower Kamthi Member does not fit into the existing facies model of anastomosing fluvial system. From the relatively higher proportion of clay and shale beds in the upper part of Lower Member it can be conjectured that the channel system attained a certain degree of anastomosis during start of Middle Kamthi sedimentation.

With regard to tectonic set-up vis-a-vis channel anastomosis, it can be said that the foreland basins are an ideal tectonic setting for the formation and preservation of anastomosed fluvial deposits (Smith and Putnam, 1980; Smith 1986; Nadon, 1994) because the thrust wedge effectively recycles the previous marine and fluvial deposits. The formation and structural evolution of a graben, on the other hand, do not necessarily involve the deposition and recycling of sediment and thus do not serve as an ideal condition for channel anastomosis (Ziegler, 1992).

Thus, in the light of failure of application of term anastomosing, a broader terminology "mixed load anabranching river" (Type 3 of Nanson and Knighton, 1996) seems more appropriate in defining the multichannel system that existed during the greater part of Lower Gondwana sedimentation.

Figure 8.6 schematically depicts the evolutionary changes in channel and sedimentation pattern during the various Lower Gondwana times.

The post-Talchir Lower Gondwana sediments were thus deposited through an uninterrupted fluvial sedimentation in varied sub-environmental domain of a north-northwesterly flowing fluvial system, characterized by a progressive change in channel pattern from a high speed braided river during Lower Barakar to a single channeled meandering river during the Middle Kamthi

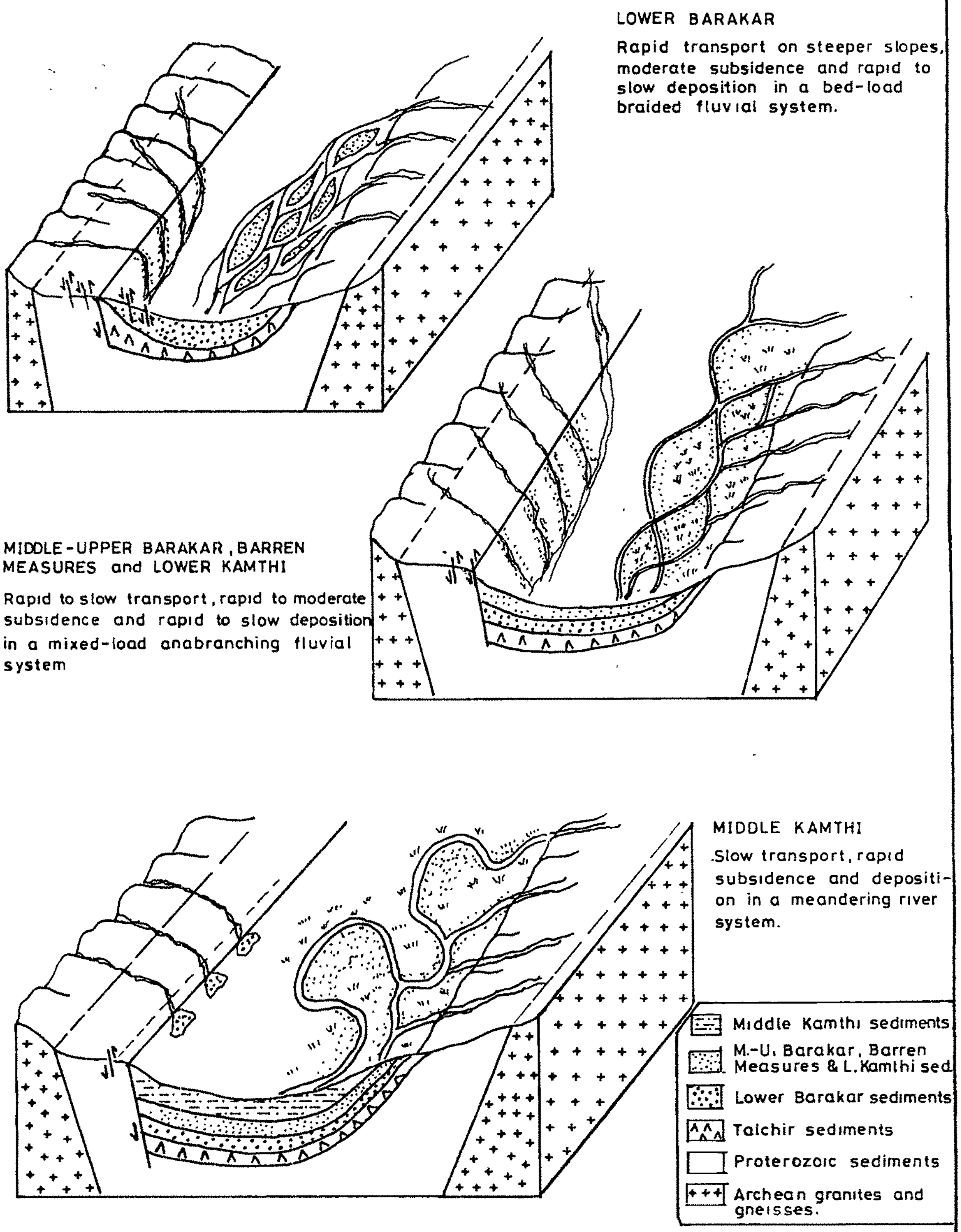


Fig. 6.6 : Schematic representation of evolutionary changes in depositional environment and channel pattern during Lower Gondwana sedimentation in Pranhita-Godavari basin.

through a mixed-load anabranching river system during the Middle-Upper Barakar, Barren Measures and Lower Kamthi times. Mutual interaction among source rocks, climate and intrabasinal subsidence was the main factor in controlling the channel pattern and consequent sedimentation during the Lower Gondwana time in Pranhita-Godavari basin.