PART IV

CHAPTER 12

DISCUSSION AND CONCLUSION

12.1. DISANG GROUP:

The Disang sediments of the area around Botsa comprise thick sequences of shales with alternations of thin bedded sandstones and siltstones. The thickness of sandstones gradually increase towards the top. The Disangs of Nagaland, including those of the area under investigation, are categorised as a flysch facies (Directorate of Geology and Mining, Nagaland, 1978).

The flysch facies is argillaceous with rhythmic alternations of shales and thin bedded sandstones (Pettijohn, 1975) and is lithologically characterised by a facies uniformity with prevalence of clastic rocks. Flysch sediments are generally poor in fossils but contain sedimentary structures such as laminations, graded bedding, etc. They are deposited below the action of water waves by turbidity currents (Cicha et al., 1968). According to Dzulynski and Walton (1965), and Friedman and Sanders (1978) flysch are marine sediments with monotonous alternating layers of shales, mudstones, siltstones and coarser sediments that form thick deposits which are laterally persistent.

The Disangs of Nagaland may be classed as dichronous, ranging from Maestrichtian to Thanetian, based on the finding of some Globotruncanap. sp. and Dandotiaspora dilata, the former by the Geological Survey of India (Dutta, 1993).
12.1.1. PROVENANCE:

The Disang sandstones contain non-undulose, undulose and polycrystalline quartz in different proportions. The non-undulose variety is considered as from an igneous source (Folk, 1968; Blatt et al., 1980). Undulose, (Folk, 1960; Blatt and Christie, 1963; Blatt, 1967; Waugh, 1970) and polycrystalline quartz (Blatt, 1967) suggest derivation of the sediments from a metamorphic terrain. Length-breadth ratios of quartz of the Disang sandstones point to igneous and metamorphic sources, the latter being dominant. According to Bokman (1962) quartz with ratios greater than 2 are most probably contributed from a metamorphic terrain while the same with ratios less than 2 are probably of igneous origin. Phyllitic and slaty material present in the sandstones are indicative of a metamorphic origin (Mack, 1984). The occasional chert, fine grained sediments and polycrystalline quartz probably suggest recycling of the sediments. Relationships among quartz, feldspar and lithic fragments indicate a recycled orogen which was probably the source of the Disang sediments (Dickinson and Suczek, 1979).

The clay minerals detected in the Disang sandstones are illite and chlorite, a major fraction of which may be detrital. Illite is an igneous mineral while chlorite is considered a low-rank metamorphic (Grim, 1968). They are present in more or less equal amounts suggesting decrease of hydrolytic processes and increase in direct rock erosion at higher latitudes.

The polymodal nature of the grain-size curves may be attributed to multiple sources of the sediments (Visher, 1969). The range in median diameter values probably suggests changes in the provenance area during sedimentation. The heavy minerals present in the sediments also point to a mixed source. Pale yellow to brown tourmaline with prismatic forms are considered to be igneous minerals (Krynine, 1946); so also zircon
Epidote, garnet, pale brown tourmaline, rutile and kyanite are low to medium grade metamorphic minerals (Poldervaart, 1955; Heinrich, 1956; Folk, 1960; Pettijohn, 1975; Choudhury and Gill, 1981). The paucity of the heavy minerals suggest recycling of the sediments.

$\text{TiO}_2/\text{Al}_2\text{O}_3$ ratios of the sandstones indicate recycling and/or an acidic source. The Al and Fe contents of the Disang sandstones are much higher than those of the average clastic rocks. Excess Al in sediments is attributed to a granitic source while excess Fe to a basaltic one (Moore and Dennen, 1970). Triangular plots of CaO-Na$_2$O-K$_2$O and Fe$_2$O$_3$-MgO-TiO$_2$ after Condie (1967) also suggest granitic and basaltic provenances.

McLennan (1989) is of the view that Eu/Eu* ratios are good indicators of degree of intracrustal differentiation processes. The negative Eu/Eu* ratios of the Disang sandstones suggest moderate differentiation processes. The HREE-depleted patterns suggest a provenance of some Na-rich granitic rocks (Potter, 1978a, b), though contribution from a metamorphic terrain cannot be ruled out.

12.1.2. TRANSPORTATIONAL PROCESSES:

The Disang sediments of the Botsa area are mostly angular to subangular. Most of the quartz grains have length-breadth ratios greater than 2. These features suggest transportation of sediments over a short distance.

CM patterns indicate that the sediments of the Disang Group were transported as uniform and graded suspensions by turbidity currents. FM, LM and AM patterns of the finer sediments indicate that they are uniform suspension deposits. The presence of both uniform and graded suspension deposits indicate
fluctuating current velocities (Passega, 1972, 1977). The range in median diameter values also suggest fluctuations in energy conditions in the sedimentary environment besides other changes in conditions of sedimentation (Rao, 1977; Venkatesh and Ray, 1981). Poor to moderate sorting, as in the case of the Disang sandstones, are indicative of variable and turbulent currents during deposition and little reworking (Wigely, 1961; Visher, 1969). Poorly sorted suspension populations indicate that the depositional basin was highly mobile which is attributed to turbulence created at depth due to incoming fresh waters laden with suspended sediments (Passega, 1972). Skewness values of these sandstones have a wide range and are mostly positive. According to Awasthi (1970) this indicates steady decrease of energy of the depositing agent. Unidirectional currents are responsible for positive skewness in sediments (Friedman, 1961; Martins, 1965). Coarse skewness values are attributed to high energy environments (Sahu, 1964). Great variation is noted in the percentages of suspension and saltation populations and in the positions of the truncation points of the saltation population which fall on the coarser sides of the curves. These are attributed to fluctuating current velocities and indicate that the combined hydraulic factors and bed roughness were variable. Much mixing is observed between the two populations which is due to variable energy conditions (Visher, 1969). Larger quantities of the suspension population suggest that the depositing medium had a high concentration of the same and that these sediments were rapidly deposited (Schumm, 1963) during the final phase of deposition when the velocity and buoyancy of flow were sufficiently reduced (Singh and Bhardwaj, 1991). Catenae of zircon and tourmaline indicate less attrition of the sediments and that they are water-laid. Discriminant function analyses suggest that fluvial and turbidity processes were responsible for transportation and deposition of the sediments.
Z.T.R. indices are indicative of rapid erosion, short transportation and quick deposition of the sediments. Parallel laminations noted in some of the sandstones owe their origin to fluctuations in current velocities in the depositional environment (Allen, 1970; Pettijohn, 1975). In turbidites they may originate due to deposition from a perfectly smooth, gradually decelerating suspension current (Kuenen, 1966).

12.1.3. DEPOSITIONAL ENVIRONMENTS:

The Disang sandstones contain some stable minerals. Stable minerals are indicators of a tectonically stable basin such as that of a passive continental margin (Folk, 1968). Chlorite and illite are constituents of a near-shore marine environment (Millot, 1942; Mason, 1966) where they form a stable pair at of a passive continental margin. This is an area of lowered rates of heat flow and reduced geothermal gradients as well as rapid subsidence and quick burial of terrigenous detritus and chemical sediments (Siever, 1979). The high concentration of K and Mg in sea water is a favourable factor for the formation of illite and chlorite (Grim, 1968).

Mean size-standard deviation, skewness-standard deviation and skewness-kurtosis plots indicate that the Disang sediments were deposited in a river environment. Studies of relationships between mean size and standard deviation indicate a rapidly sinking depositional basin with low tectonic uplift of the source (Inman, 1952; Cadigan, 1961). The sediments may belong to a lower deltaic plain environmental regime. Discriminant function analyses of these sandstones suggest that they were deposited in fluvial and shallow agitated marine environments.

\[ \text{SiO}_2 \text{ vs } K_2O/Na_2O \text{ and } SiO_2/Al_2O_3 \text{ vs } K_2O/Na_2O \text{ binary plots indicate a passive continental margin (Roser and Korsch, 1986). } K_2O/Na_2O \]
ratios, which are greater than 1, are indicative of sediments deposited in plate interiors at passive margins (Bhatia, 1983) in exogeosynclinal environments (Middleton, 1960). Triangular plots of \((\text{Fe}_2\text{O}_3 + \text{MgO})\), \(\text{Na}_2\text{O}\) and \(\text{K}_2\text{O}\) also indicate an exogeosynclinal set-up. Exogeosynclinal sediments are deposited in a near-shore environment (Blatt et al., 1980) and are derived from older metamorphic and sedimentary sources (Middleton, 1960). According to White (1970) the marine environment is enriched in B. The B content in the Disang sandstones suggest such an environment. Ternary plots of B, Rb and Ga and binary diagrams of B and Ga, and B and Rb suggest marine, fresh water and mixed environments respectively (Degens et al., 1957). Ga is highly mobile in the biogeochemical cycle (Goldschmidt, 1954). Its low occurrence indicates inactivity in the biological process (Sinha and Singh, 1964).

The Disangs are poor in their fossil content though some pelecypods and gastropods have been recorded from the upper horizons of the same in the Botsa area (Mishra, 1988). The presence of these fossils suggest a shallow marine environment. However, no such fossil is recorded from the Upper Disangs of Upper Assam (Dutta, 1993).

The polycrystalline and strained quartz present in appreciable amounts in the Disang sediments are indicative of low mineralogical maturity (Blatt, 1967). The length-breadth ratios of quartz also suggest the same (Bokman, 1952). However, \(\text{Cr}/\text{V}\) ratios (Dykpiu, 1957) suggest good ventilation in the depositional environment.

The sandstones are found to be more enriched in \(\text{K}_2\text{O}\) than \(\text{Na}_2\text{O}\) and \(\text{CaO}\). Further, the \(\text{TiO}_2/\text{Al}_2\text{O}\) ratios are higher than the average continental rocks. In granites \(\text{K}_2\text{O}\) is more or less equal to that of \(\text{Na}_2\text{O}\) and \(\text{CaO}\). The relative enrichment of \(\text{K}_2\text{O}\) suggests chemical maturation (Middleton, 1960). The high \(\text{TiO}_2/\)
Al₂O₃ ratios also indicate the same (Spears and Sotiriov, 1976). The low Na/Al and Na/K ratios are indicative of graywackes (Pettijohn, 1957).

The negative Eu values suggest moderately deep-water anoxic conditions during deposition (Freyer, 1977). This is supported by the presence of pyrite in the Disang sediments. Ni/Co ratios suggest decreasing Eh conditions in the depositional basin (Dykpi, 1979). Quartz-rich sandstones have low values of La/Yb ratios and ΣREE (Cullers et al., 1979). The Disang sandstones, however, show high values compared to the average sedimentary rocks. The average quartz-clay ratio of the Disang sandstones is as low as 1.3 but the La/Yb ratios and ΣREE is less. These abnormal results suggest that the Disang sandstones have suffered the "quartz-dilution effect". This is supported by the floating appearance of quartz on the matrix.

The Z.T.R. indices indicate poor to moderate maturity of the sediments. From petrographic and geochemical studies it may be concluded that the Disang sandstones of the Botsa area are graywackes to subgraywackes. These two rock types are characteristic of an exogeosynclinal environment. The cementing materials of these rocks include iron oxide, silica and calcium carbonate. The iron oxides are dominant while silica is scarce. The sandstones of this group of the Botsa area show the development of load casts in some sections. Their origin is attributed to differential loading of the underlying hydroplastic muds which cause vertical readjustment when sand sinks downwards with compensatory upward movement of mud (Pettijohn, 1975). Some concretions are also observed in the Disang sandstones. Concretions form by post-depositional solution and precipitation (Pettijohn, 1975).

12.1.4. DIAGENESIS:

The Disang sandstones show a series of alteration in
mineralogical composition which may be grouped as early and post
diagenetic. The precipitation of hematite as cement around the
detritals and in-situ alteration of plagioclase are common early
diagenetic features. Feldspars are altered to illite during
diagenesis (Grim, 1968, Mack, 1978, Iman and Shaw, 1985) where
the excess K of feldspars is held by the illites (Keller, 1964).
The in-situ alteration of feldspar to illite is well established
(Pettijohn, 1975). Chlorite, a common accessory detrital mineral
of immature sands, may be an alteration product of primary micas.
It replaces illite when diagenesis merges into metamorphism.
Chlorite is a characteristic constituent of the microcrystalline
matrix of graywackes (Selley, 1976). These clay minerals forming
the matrix of the sandstones appear to have acted as barriers
against the silica solutions from reaching the quartz grains and
forming overgrowths (Heald and Lairesse 1974). The sutured edges
of the mica grains suggest the effect of pressure solution during
deep-burial diagenesis.

12.2. BARAIL GROUP :

The Barail Group of rocks exposed in the area are made
up of sandstones with thin intercalations of papery shales.
Sedimentation of the Barails began with the deposition of massive,
thick bedded, multi-layered sandstones (Sahu and Naik, 1988) over
the Disangs without a hiatus followed by thin bedded ones. They
represent a molasse facies (Directorate of Geology and Mining,

The molasse facies consists of deposits that have been
produced due to extensive erosion of highlands after the final phase
of an orogeny and deposited in marine, brackish or fresh-water
environments. In these sediments laminations, ripple marks, etc.
are common features (Cicha et al., 1968). Pettijohn (1975)
considers molasse sediments as shallow-water deposits of deltas,
closed bays or near-shore marshes which originate above wave base. These areas represent transitional environments which are made up mostly of recycled sediments with rock particles of sedimentary and low-grade metamorphic origin. The rock types of this environment are a mixture of graywackes, subgraywackes and quartzose sandstones (Kukal, 1968). According to Friedman and Sanders (1978) the molasse is a wedge-shaped body with shallow marine and non-marine strata, the sediments of which are derived due to erosion of older geosynclines, including flysch. The age of the Barail Group of rocks was considered as Oligocene (Mathur and Evans, 1964; Krishnan, 1968). However, Handique et al. (in Press), based on fossil evidence, opine that the Barails range from Late Eocene to Oligocene.

12.2.1. PROVENANCE:

The quartz types of the Barail sandstones include non-undulatory, undulatory, polycrystalline and reworked. Non-undulose variety of quartz, which are derived from igneous sources (Folk, 1968; Blatt et al., 1980), are most dominant in these sandstones. The undulose type is representative of a metamorphic source (Folk, 1960; Blatt and Christie, 1963; Blatt, 1967; Waugh, 1970). Polycrystalline quartz is also derived from a metamorphic terrain (Blatt, 1967). Length-breadth ratios of quartz, as deduced following Bokman (1952), indicate both igneous and metamorphic sources, the former proportionately greater. The presence of slaty and phyllitic materials indicate a low-grade metamorphic source (Mack, 1984) for the sediments. The presence of chert, some polycrystalline quartz and metasedimentary particles in sandstones, such as those of the Barails, suggests recycling of sediments from an orogenic source. Relationships of quartz, feldspar and lithic fragments also suggest the same (Dickinson and Suczek, 1979). Some of the coarser quartz grains of the Barail sandstones are well rounded.
and some have attained a high sphericity. These features, together with quartz detritals showing remnants of overgrowths suggest recycling (Lewis, 1984).

The Barail sediments contain illite and chlorite, a minor fraction of which may be original. According to Grim (1968) illite and chlorite are igneous and metamorphic minerals respectively. Their occurrence in similar proportions suggests more of direct erosion rather than weathering of the provenance.

The grain-size curves are bimodal and polymodal. Such curves indicate multiple sources of the sediments (Visher, 1969). Inconsistent median diameter values of these sandstones are probably due to changes in the provenance during sedimentation processes. The presence of heavy minerals like the opaques and zircon in the Barail sandstones suggest an igneous source (Poldervaart, 1955); so also yellow to brown prismatic tourmaline (Krynine, 1946). Pale brown tourmaline, epidote, garnet, rutile and kyanite indicate a low to medium grade metamorphic source (Poldervaart, 1955; Heinrich, 1956; Folk, 1960; Pettijohn, 1975; Choudhury and Gill, 1981). Their overall paucity suggests recycling of the sediments. TiO$_2$/Al$_2$O$_3$ ratios of the sediments suggest recycling and/or an acidic provenance. The Barail sediments are enriched in aluminium and Al-enriched sediments are derivatives of granitic sources (Moore and Dennen, 1970). A granitic source is inferred from the CaO-Na$_2$O-K$_2$O and Fe$_2$O$_3$-MgO-TiO$_2$ relations of Condie (1967). Studies made after McLennan (1989) of Eu/Eu* relationships suggest that intracrustal differentiation processes during the formation of the Barail sandstones were not as pronounced as they were for the Disangs. The Barail sandstones are depleted in HREE which, according to Potter (1978a, b), is a feature of Na-rich granitic derivatives.
12.2.2. TRANSPORTATIONAL PROCESSES:

The length-breadth ratios of quartz grains of the Barail Group suggest short transportation of the sediments. The subrounded to subangular nature of the fine quartz grains also suggest transportation over short distances. According to Plumley (1948) rounding in case of finer grains require longer transportation.

The sediments were transported in uniform and graded suspensions, most probably by fluvial processes. FM, LM and AM diagrams of the finer sediments indicate that they are uniform suspension deposits (Passega and Byramjee, 1969). Two or more populations together are indicative of fluctuating current velocities (Passega, 1972, 1977). The values of mean size, skewness and kurtosis are moderately wide-ranging which are also indicative of fluctuations in energy conditions or changes in conditions of sedimentation (Rao, 1977; Venkatesh and Ray, 1981). The sorting of the Barail sandstones is more or less moderate. This is attributed to little reworking due to turbulent currents during sedimentation (Wigely, 1961; Visher, 1969). Fine positively skewed sands, such as those of the Barails, indicate relatively calm and steadily decreasing energy state of the depositing medium (Awasthi, 1970). The positive skewness is also attributed to unidirectional currents (Friedman, 1961; Martins, 1965). The coarse skewness is indicative of a high energy environment (Sahu, 1964). The Barail sediments were probably deposited by rivers with fluctuating velocities. The variability in the truncation points, much mixing and variable percentages of the suspension and saltation populations are attributed to fluctuating currents which may exist due to bed roughness and hydraulic factors (Visher, 1969). The high concentrations of the suspension population suggest rapid dumping of the sediments (Schumm, 1963) during the final phase of deposition (Singh and Bhardwaj, 1991). Catenae of zircon and
tourmaline indicate that these are water-laid deposits. In case of the Barails attritional processes were minimum. Discriminant function analyses of the sandstones suggest that fluvial and turbidity currents were responsible for transportation of the Barail sediments. However, from other studies it is suggested that fluvial processes were dominant.

The laminations that are common in the Barail sandstones indicate fluctuating energy conditions in the depositional environment (Allen, 1970; Pettijohn, 1975), though particles of equal weight, density and shape moving along the bottom also tend to segregate forming laminations (Kuenen, 1966). Ripples, though not very common, are noted. Fluctuating currents have probably not allowed their development. The ripple indices indicate moderate to high velocity currents (Reineck and Wunderlich, 1968). The ripples are sinous and asymmetric, suggesting unidirectional currents. The base of the Barails are noted for their massive, thick bedded, multi-layered sandstones. Beds of this nature owe their origin to very rapid sedimentation (Reineck and Singh, 1980).

12.2.3. DEPOSITIONAL ENVIRONMENTS:

The Barail sandstones contain an abundance of stable minerals which indicate a passive continental margin (Folk, 1968). Chlorite and illite form a stable pair in near-shore environments at these margins (Millot, 1942; Mason, 1966). A passive margin is a tectonically stable area with lowered rates of heat flow and low geothermal gradients. Here, subsidence is rapid while terrigenous detritus is quickly buried (Siever, 1979). The high contents of K and Mg in sea water may be a probable cause of the development of some of the illite and chlorite respectively (Grim, 1968) of the Barails. The occurrence of illite and chlorite in the Barails, which are most probably fresh-water sediments, is suggestive of transgression and regression.
Mean size-standard deviation, skewness-standard deviation and skewness-kurtosis relationships suggest that the Barail sediments were deposited in a river environment. These sediments were probably deposited in a deltaic area. Mean size-standard deviation relationships suggest that the depositional basin was rapidly subsiding with low tectonic uplift of the source (Inman, 1952; Cadigan, 1961). Discriminant function analyses of these sediments indicate shallow agitated marine and fluvial environments.

$SiO_2$ and $K_2O/Na_2O$, and $SiO_2/Al_2O_3$ and $K_2O/Na_2O$ relationships (Roser and Korsch, 1986) indicate a passive continental margin for the Barail sediments. The $K_2O/Na_2O$ ratios of these sediments are greater than 1. Such values suggest deposition in plate interiors at passive margins (Bhatia, 1983) in exocontinental environments (Middleton, 1960). Triangular plots of $(Fe_2O_3 + MgO)$, $Na_2O$ and $K_2O$ also indicate an exocontinental set-up. Being derivatives of older metamorphic and sedimentary sources (Middleton, 1960) these sediments are deposited in a near-shore environment (Blatt et al., 1980). The boron contents of the Barails point to a marine environment as according to White (1970) this environment is enriched in boron. Ternary plots of B, Rb and Ga also suggest the same whereas binary diagrams of B and Ga, and that of B and Rb suggest marine, fresh-water and mixed environments respectively (Degens et al., 1957). Marine transgression is probably responsible for the anomalous boron contents in the Barail sandstones. According to Goldschmidt (1954) gallium is highly mobile in the biogeochemical cycle. Its low occurrence suggests lack of biological activity (Sinha and Singh, 1964).

The moderate maturity of the Barail sandstones is noted in that they contain minor proportions of polycrystalline and strained quartz (Blatt, 1967). Length-breadth ratios of quartz also suggest the same (Bokman, 1952). Cr/V ratios
(Dykpiiv, 1979) suggest that conditions of ventilation at the depositional site was good.

The rocks under study are chemically mature as indicated by the relative enrichment of $K_2O$ over $Na_2O$ and $CaO$ (Middleton, 1960) and high $TiO_2/Al_2O_3$ ratios (Spears and Sotiriov, 1976). Low values of $Na/Al$ and $Na/K$ are suggestive of graywackes (Pettijohn, 1975). The sandstones of the Barail Group contain siliceous and ferrugenous cements, the former dominant. These cements, however, are scarce in the finer sandstones.

The $Eu/Eu^*$ ratios show both negative and positive values which indicate anoxic and oxic conditions respectively during deposition (Freyer, 1977). The presence of limonite and lack of pyrite suggest that conditions in the depositional environment was an oxidising one. Such variations are probably due to a sloping basin floor or uneven basin configuration. Ni/Co ratios suggest lowering Eh conditions in the depositional basin (Dykpiiv, 1979). Compared to the Disang sandstones the Barails have higher EREE contents which is attributed to the high zirconium content. The Z.T.R. indices suggest moderate maturity of these sediments.

Load casts, as noted in some of the Barail rocks, develop due to unequal loading over underlying plastic layers. Ripples develop in the initial stages of the lower flow regime in a near-shore environment where particle motion is rippled and depth of water uniform (Pettijohn, 1975).

The Barail sandstones may be classed as litharenites to sublitharenites. These rocks are typical of an exogeosynclinal environment (Dapples et al., 1953). Subgraywackes (litharenites) are shallow-water deposits.
12.2.4. DIAGENESIS:

Most of the illite of the Barail sandstones are probably diagenetic alteration products of the feldspars (Grim, 1968; Pettijohn, 1975; Mack, 1978; Imam and Shaw, 1985). The excess of potassium of the feldspars is held by the illites (Keller, 1964). Some of the chlorites are probably alteration products of the illites but mostly that of primary micas. According to Selley (1976), chlorite is a characteristic constituent of the microcrystalline matrix of graywackes. Overgrowths of quartz are lacking in the Barail sandstones which may be attributed to the illitic and chloritic matrix acting as barriers against silica solutions from reaching the quartz detritals (Heald and Laresse, 1974). Deep-burial diagenesis causing pressure solution is inferred from the sutured edges of the micas.

12.3. CONCLUSION:

The Disang rocks under study are graywackes to subgraywackes. The sediments were derived as a result of rapid erosion from orogenic sources where climatic conditions were semi-humid to semi-arid. The provenance include granitic, volcanic (probably basaltic), low to medium grade metamorphic and sedimentary terrains. The Disang sandstones are texturally classified as silty sands and comprise uniform and saltation populations. They were transported over a short distance in uniform and graded suspensions by fluvial and turbidity processes, the currents of which were mainly unidirectional and constantly fluctuating. The Disangs of the area were deposited in an exogeosynclinal set-up that belonged to a passive continental margin. Sedimentation took place in a shallow marine environment with probably an undulating floor and/or shallowing of the basin due to which both reducing and oxidising conditions prevailed. The maturity and sorting of the sediments representing a transitional facies is poor to moderate. Iron oxides, some
silica and a little calcium carbonate form the cements. Diagenesis, due to deep burial of the sediments, has modified the original mineralogy.

Immediately after the Disangs were deposited sedimentation of the Barails began with the deposition of massive, thick, multi-layered sandstones followed by thinner beds. These sediments, litharenites to sublitharenites with silica as the dominant cement followed by a little iron oxides, were derived mainly from a granitic source and to a lesser extent from low-grade metamorphic terrains. From studies conducted it is inferred that these moderately sorted sediments are recycled. The Barail sandstones are texturally classified as silty sands and comprise uniform and saltation populations which were transported over a short distance in uniform and graded suspensions by fluvial processes and probably to a minor extent by turbidity currents. The transporting currents were more or less unidirectional and constantly fluctuating. These sediments were deposited in an exogeosynclinal set-up of a passive continental margin. The depositional environment was probably a delta where oxidising conditions were dominant. Transgression and regression probably took place during Barail sedimentation. Deep-burial diagenesis, to some extent, has changed the original mineralogy of the rocks.