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LITHOFACIES ANALYSIS OF CONGLOMERATES IN THE NORTH-EASTERN PART OF NIGER DELTA, NIGERIA

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ABSTRACT

Lithofacies analysis of a northwest – southeast trending conglomeratic belt with an areal coverage of about 405 km^2 showed five broad sedimentary facies:
- Orthoconglomerate facies comprising clast-supported conglomerates with poorly sorted medium to very coarse-grained sands forming the matrix.
- Unstratified paraconglomerate facies comprising matrix – supported conglomerates with muddy or sandy matrix without stratification or intercalation of sandstones.
- Interstratified paraconglomerate facies comprises matrix – supported conglomerates with interstratified sand beds.
- Gravelly sandstone facies consisting of conglomeratic sandstone with medium to very coarse – grained matrix.
- Sandstone facies comprises sandstone beds with fine and medium to coarse-grained, weakly cemented sandstones.

The lithosections exhibit paucity of sedimentary structures. Imbricate structures are rare. Discoidal pebbles, poor sorting and repetitive fining and coarsening upward motifs are common features. The conglomerates have little or no overbank deposits; rather there is an abundance of coarse-grained facies. There are no sedimentary structures apparent. On these lines of evidence the conglomeratic deposits are believed to be of coarse-grained (pebbly) braided river environment.

INTRODUCTION

The study area is located within the region bounded on the northwestern limits by Oniong-Ono (Long. 7° 43'E and Lat. 5° 21'N), Mbiakpa Ibakesi (Long. 7° 42.5'E and Lat. 5° 21'N), and Usuk Ibakesi (Long, 7° 43.5'E and Lat. 5° 19.5'N). The southeastern limit is marked by Nwaniba (Long. 8° 00'E and Lat. 5° 16'N) and Oku Iboku (Long. 8° 00 and Lat. 5° 8'N). The gravel occurrence has a northwest – southeast trend. The study area covers about 405 Km2 in the northeastern part of the Niger Delta (Fig. 1). In this paper, the term solidated deposits withgravels forming 30 to 40% of the framework grains (Pettijohn, 1975; and Walker, 1975). The sizes of the gravels in the study area are mostly granules, pebbles, and cobbles (2mm – 256mm).

The pioneering works of Amajor (1986) and Petters (1989) dealt with the sedimentology of the deposits. However, the present study is important in order to refine the environmental interpretation of the lithofacies. The scope of this study also includes a possible stratigraphic correlation of the lithosections in the study area and adjoining areas.

Geological Setting:

The conglomerates encountered in this study are a distinct facies within the lower Benin Formation (or its surface equivalent, Pliocene-Recent Coastal Plain Sands) and the top of the underlying Ogwashi – Asaba Formation (Oligocene – Miocene) (Petters, 1989).

Benin Formation comprises mostly of sandstones with shale intercalations. The sands and sandstones are mostly coarse-grained, pebbly, to fine-grained. Generally, they are poorly sorted, the grains are sub-angular to well-rounded. The sands are white or yellowish brown. Lignite streaks also occur in this formation (Short and Stauble, 1967; Reyment, 1965; and Weber and Daukoru,

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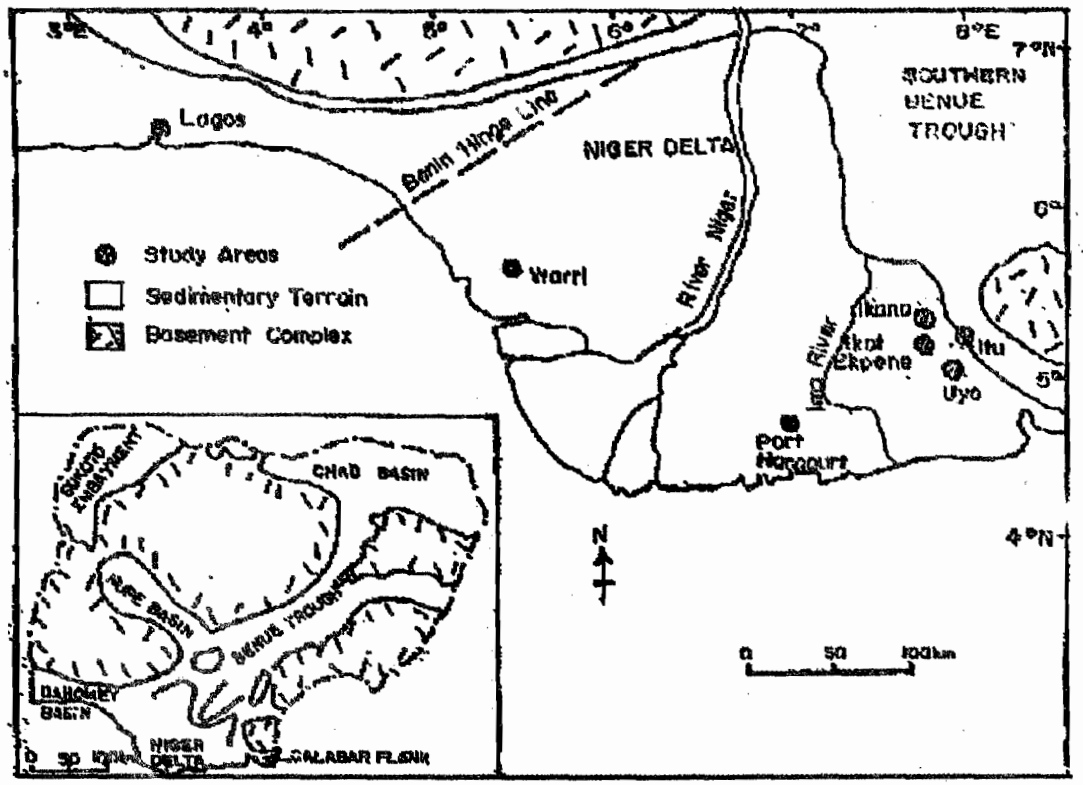

Fig. 1: Geologic sketch map of Niger Delta showing areas of study.

1976). From his study of these conglomerates, Amajor (1986) distinguished four facies namely:

Facies A: Quartz – pebble conglomerate

Facies B: Pebbly sandstone

Facies C: Interstratified pebbly sandstone and sandstone

Facies D: Sandstone

Opinions on depositional environment(s) of these conglomerates are diverse. Amajor (1986) interpreted the gravel beds to be of alluvial fan origin while Petters (1989) interpreted them to be beach environments (marginal marine setting), although a close scrutiny of his pebble morphometric results suggests fluvial origin.

METHODOLOGY:

The geological mapping was carried out using topographic maps of Ikot Ekpene sheets of scale 1: 100,000, Ikot Ekpene (NW, NE, SE) sheets of scales 1:50,000 and Uwet sheet of scale 1:50,000.

Each lithosection was graphically logged. Samples of the gravel at different stratigraphic levels in various localities were collected. The samples were carefully packaged and labelled for laboratory analysis. The sedimentary aspects of these gravel beds were noted using the checklists for sedimentary terrains (Tucker, 1989; and Ahmed and Almond, 1983).

LITHOSTRATIGRAHY:

Gravel and sand beds form a belt about 45 km long and 9km wide (fig. 1). The descriptions of the lithologic sections at selected localities illustrate the nature of the gravel occurrences and the salient attributes of some units. The gravels are mostly clast or matrix-supported (Rust, 1979). The gravel and sand beds do not show any regional dip. They are generally structureless, there being no cross-stratification of any sort. The gravel beds show erratic facies changes by thinning out or splitting into two or more smaller gravel beds even between closely spaced localities.

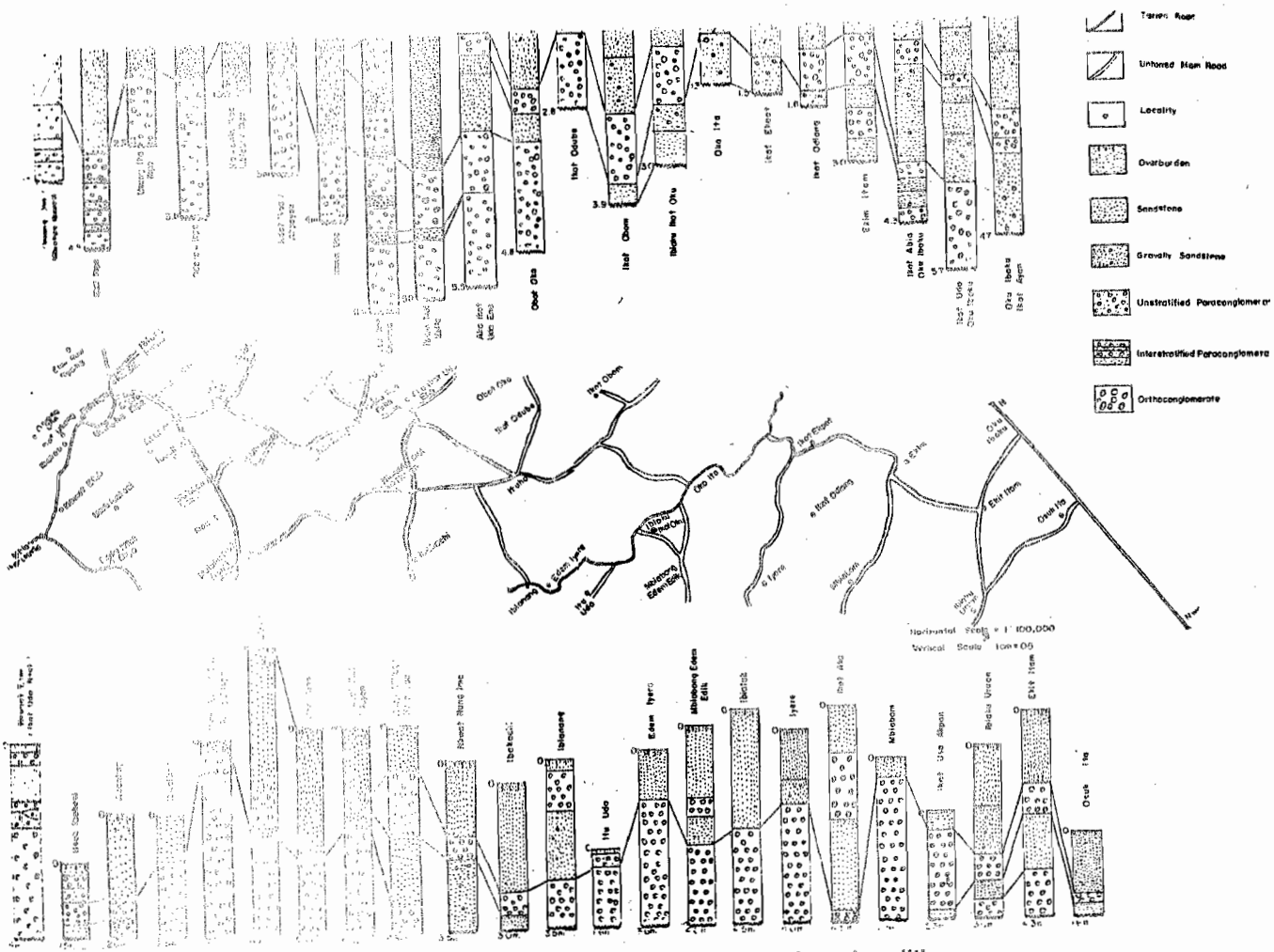

Fig. 2: A sketch showing locations and lithologic sections of various localities.

Despite the lack of continuous exposure, an attempt was made to correlate lithologic units (Fig.2).

In a broad sense, the lithostratigraphic units in the study area were grouped into five facies: Orthoconglomerate facies, unstratified paraconglomerate facies, interstratified paraconglomerate facies, Gravelly sandstone facies and sandstone facies.

Orthoconglomerate facies:

This facies consists of conglomerates with grain-supported fabric. The clasts are subangular to rounded and are set in a matrix of poorly sorted medium to very coarse-grained sands.

This lithofacies is loosely consolidated and sedimentary structures are not apparent. The bedding planes are sharp, planar, and horizontal (Fig 3).

The exposed thickness of this facies varies from 0.5m to 4m. In some localities like Ikot Ekere and Odoro – Ikpe, imbrication was observed. In some other localities like Ikot Udo Nsek and Nkwot Etok, indurated ferruginized layers (ironstone bands) varying from 2.5cm to 6cm thick were noted.

This facies show normal size grading but some localities display reverse size grading. Sedimentary structures are absent. The clasts range between 0.2cm and 13cm in diameter. This facies is equivalent to facies A of Amajor (1986), facies G of Williams and Rust (1969) and facies Gm of Miall (1977).

Unstratified Paraconglomerate facies:

This facies (Fig. 4) comprises

Fig. 3: Shows the orthoconglomerate facies with sandstone facies.

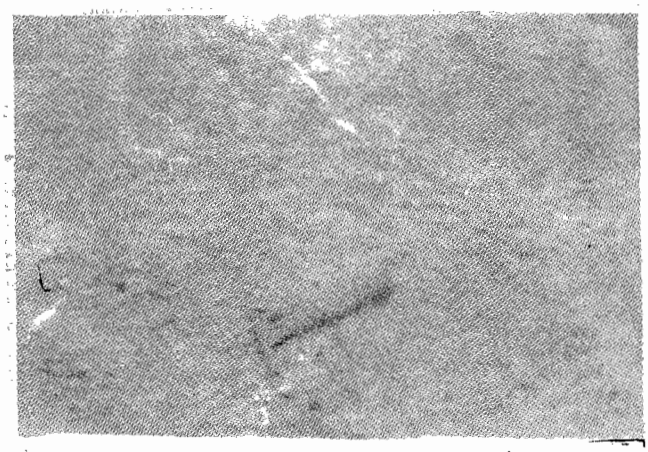

Fig. 4: Shows unstratified paraconglomerate facies

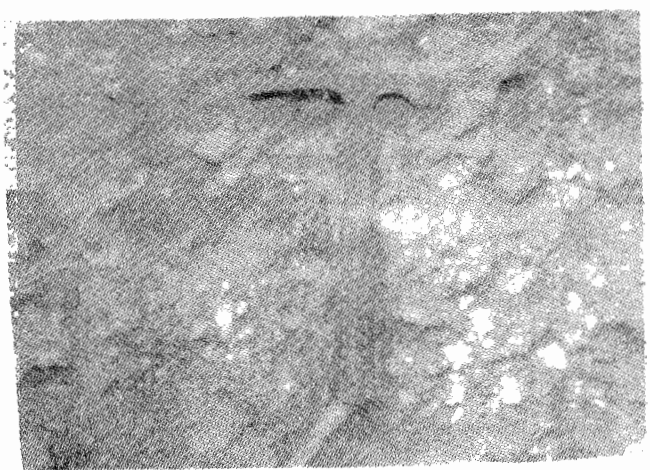

Fig.5: Shows Gravely sandstone facies

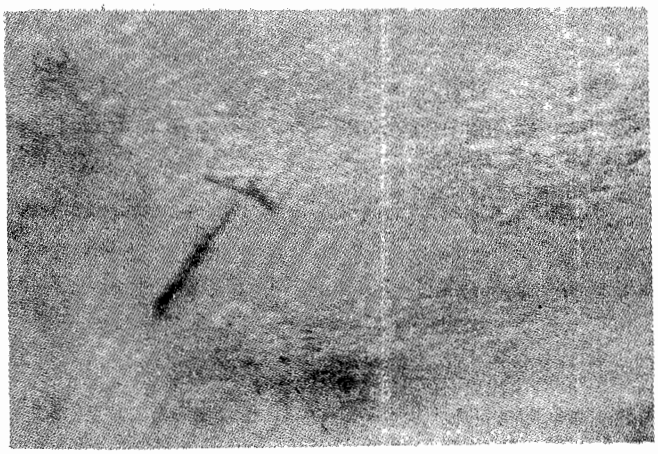

Fig.6: Shows interstratified paraconglomerate facies.

unstratified matrix – supported conglomerates with clast-sizes ranging from 0.5cm to 5.5cm. The quartzitic clasts are subangular to rounded and are in a fine – to coarse – grained sandy matrix or mud – matrix.

In some localities, such as Ikot Udo Nsek, there are ferruginised bands up to 5cm thick. This facies may range in exposed thickness up to 2.8cm. The bedding planes are sharp, planar and horizontal.

In certain localities, such as Ikot Ekere and Usuk Ibakesi, the long axes of the clasts are oriented parallel to the bedding. This facies shows normal size grading, but in some localities, reverse size grading is displayed. This facies is similar to facies Gms of Rust (1979).

Interstratified Paraconglomerate facies:

This is a matrix – supported conglomerate with intercalations of sandstones. The sandstones are very coarse-grained to medium-grained with beds ranging in thickness from 3cm to 20cm. They lack sedimentary structures and fossils. In these sandstones, there are occasional granules and pebbles.

The gravel beds of this facies have clast size ranging between 0.2cm and 6.5cm. The pebbles are poorly to moderately well-sorted and, in localities such as Nsit Ikpe and Odoro Ikpe, their maximum projection areas are parallel to the bedding. The bedding planes are sharp, planar and horizontal. The matrix is

made up of coarse-to medium-grained sand. The pebbles are mostly quartzitic in composition, some are pegmatitic, felsparthic, and gneissic. The colour of this facies varies from shades or orange, through brown, red to yellow and white (Fig. 5). The gravels show facies change in overall thickness from 0.2m to about 3m. In some localities, this facies displays kaolinitic sandy matrix with smooth rounded pebbles. This facies is similar to facies C of Amajor (1986).

Gravelly Sandstone Facies:

This facies (Fig 6) ranges up to 2.8m in exposed thickness and contains framework element ranging from granules to pebbles. These framework elements are subrounded. They are moderately well-sorted to poorly sorted and are mostly quartzitic in composition. The colour shades includes red, yellow, orange, brown, and white. The sand matrix is medium to very coarse grained.

As observed by Amajor (1986), the sand/clasts ratio is higher than that of orthoconglomerate and paraconglomerate facies, the gravels are of smaller sizes better sorted and rounded with an improved matrix sorting. This facies is massive, friable, unconsolidated and does not exhibit any sedimentary structures nor contain any fossils. The bedding planes are sharp, planar and horizontal. This facies corresponds to facies B of Amajor (1986) and closely approximates facies Sh of Miall (1977) though without horizontal laminations and parting lineations.

Sandstone Facies:

This facies comprises fine through medium to coarse-grained unconsolidated sands. It is moderately well-sorted and the colour shades include red, orange brown, yellow, and white. The facies ranges up to 2.5m in exposed thickness. It is mostly quartzitic in composition and is structureless. (Fig 3)

They do not contain gravels as their framework components. This facies is friable and has no macrofossils. It corresponds to facies D of Amajor (1986) and shows some similarity with facies Sh of Miall (1977) though horizontal and cross-stratifications were not observed.

DISCUSSION AND CONCLUSION:

Most logged sections exhibit orthoconglomerate facies (similar to facies Gm of Miall (1977) and Facies A of Amajor (1986), gravelly sandstone facies (similar to Facies B of Amajor (1986) and Facies Sh of Mial (1977) and sandstone facies [similar to facies D of Amajor (1986) and Facies Sh of Miall (1977)] which suggest deposition in either a braided stream or an alluvial fan.

Consideration of the north-south trends of the major faults of the study area (Petters, 1989) which do not conform with the northwest-southeast trend of the conglomerates somewhat negates alluvial fan origin of the gravel deposits. This is because alluvial fan deposition requires confinement by structural features or ancient mountain fronts Rust, 1979).

The logged facies in the study area are generally massive which points to braided river deposit (Miall, 1977). This is supported by Rust (1979) who notes that the most abundant facies of coarse-grained river is horizontally bedded clast-supported gravel which may appear massive where bedding is thick and uniform.

The lithosections of the conglomerates display repetitive fining and coarsening upward successions which are an indication of deposition in fluvial environments (Miall, 1978; Koster and Steele, 1984). Also, granulometric and pebble morphometric results on these conglomerates corroborate fluvial origin of the conglomerate (Inyang In Press). Furthermore, the essentially linear outcrop pattern of the conglomerate belt in the study area is consistent with deposition in a valley -confined braided river.

The clast sizes of these deposits being within gravel range precludes purely deltaic mode of deposition (Morgan, 1970) and

meandering stream deposition (Rigby and Hamblin, 1972). Futhermore, the poorly sorted nature of the conglomerates, paucity of imbricate structures and discoidal pebbles and non-association with marine strata (since the deposits are within the continental Benin Formation) are lines of evidence which do not favour a beach environment model.

Notwithstanding, Reading (1978) noted that some humid alluvial fans with deposits similar to braided streams can develop without any lateral confinement. Thus similarities of these conglomeratic deposits with the braided stream facies of Miall (1977) and the alluvial deposit facies of Amajor (1986) show that though deposited in a braided river environment, it was not in isolation from other depositional environments such as humid alluvial fans and beach environments (Reading, 1978).

The clast sizes of the framework grains, the repetitive fining and coarsening upward sequences, the linear outcrop pattern and corroborated statistical results support the interpretation of the conglomerates as being of coarse-grained (pebbly) braided river environment.

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