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Palaeocurrent and facies analysis of Ajali Sandstone in Western Anambra basin, Nigeria

Edirin Akpofure*, Tombra S. Akana

Department of Geology, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria

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ABSTRACT

Outcrops of the Campanian - Maastrichtian Ajali Sandstone in Ayogwiri, Fugar and Orame in the Western Anambra Basin allow for the recognition of palaeocurrent fabric and facies characterization of the formation. Detailed outcrop logging was carried out and production of graphic logs was made for each outcrop location. The Ajali is extensively cross-stratified with different types of cross-bedding, such as the planar, trough, and herring-bone cross-beddings. Palaeocurrent directions of the cross-beds were taken using the compass-clinometer to elucidate the palaeocurrent direction of the environment of formation and rose diagrams were constructed for each bed. The Ajali Sandstone is made up of two basic facies. The basal facies, is made up of thinly laminated, heterolithic beds of the shoreface environment. The upper facies consists mainly of cross-bedded sandstones of a tidally influenced shallow marine environment. The major palaeocurrent direction of the Ajali Sandstone in the studied area was in the NE direction which infers the sediment provenance source to be the uplifted Abakiliki Anticlinorium. However, subordinate direction to the south occurs in Orame1.

1. Introduction

The origin of many sedimentary basins in West Africa is associated with the splitting up of the Gondwana super continent. The Benue Trough is the failed third arm of a rift associated with this event and basins resulted from this differential subsidence of fault blocks. The component basins include the Gongola basin, the Yola rift and Mamfe arms, the Benue basin, Abakiliki Anticlinorium, the Afikpo basin, the Calabar flank, the Anambra basin and the Niger–Delta basin. Before the Santonian active tectonic phase of folding, faulting and uplift, the Anambra basin was a platform only thinly dripped by older (Albian) sediments. The Santonian tectonic event affected the Cretaceous rocks in the Benue Trough and Abakiliki basin. The compression forces led to the folding and uplift of the Abakiliki basin which formed an anticlinorium and a westward translation of the depocenter towards Anambra basin and Afikpo basin resulted (Nwajide and Reijer, 2004).

Several lithic fills occur in the Anambra basin. These lithic fill constitute the “Proto Niger Delta” (Nwajide and Reijers, 1996). Sedimentation began with the deposition of the Nkporo Group which is made up of The Enugu Shales and the Owelli Sandstone. The Mamu Formation which forms the lower coal measure overlies the Nkporo Group. Ajali Sandstone conformably overlies the Mamu Formation, while the Nsukka Formation, which is the top of the coal measure group and the youngest lithologic unit of the Anambra basin, overlies the Ajali Sandstone (Hoque and Ezepue, 1977). The Ajali Sandstone is a major clastic lithologic unit of Campanian-Maastrichtian age occurring within the Anambra basin.

Depositional environment of the Ajali Sandstone has been an issue of controversy. Reyment (1965) inferred a continental environment for the Ajali Formation by noting that the formation is between two parallic surfaces; the underlying Mamu Formation and the overlying Nsukka Formation thus indicating a continental origin. Amajor (1987) subdivided the Ajali Formation in Okigwe area into two fining upward sequences, each of which is divided into three sub-facies of a fluvial – marine depositional environment. Ladipo (1986, 1988), studied the sedimentary structures and palaeocurrent analyses of the Ajali Sandstone, and suggested a tidally influenced regime for the sand bodies. Tijani et al. (2010) inferred from the textural indices, the depo-environmental discrimination of the Ajali Sandstone revealed a fluvial/river system-dominated sedimentary process.

Akpofure and Etu-Efeotor (2013b), by using sedimentary structures, biostratigraphic and textural characteristics of the Ajali

* Corresponding author.
E-mail addresses: edirinakpofure@yahoo.com (E. Akpofure), brossatombra@yahoo.ca (T.S. Akana).

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Sandstones suggest a shoreface or shallow marine depositional environment with tidal and fluvial influences.

In the present work, sedimentological studies of the Ajali Sandstone in Western Anambra basin was embarked upon to determine the palaeocurrent direction and facies stacking patterns for better understanding of the Ajali Sandstone and it's depositional environment. Ayogwiri, Fugar and Orame are situated in Etsako West Local Government Area of Edo State. The area is covered by the Ajali Sandstone. Accessibility to and within the study area is fairly good. There are good network of tarred roads including Auch-Ibillo road, Auchi-Agenebode road among others. The Sandstone exposures in the area are along road cuts and in quarries (Fig 1.).

2. Previous work

The literature is replete with work on the Anambra basin; some are on regional basis while others are not. Regionally, the Ajali Sandstone comprises thick successions of sandstones with thin beds of mudstone and shales near the base. The Ajali Formation is extensively cross-stratified into different types of cross-bedding including: Planar, trough and herring-bone cross-bedding which occur at different stratigraphic levels. The cross-beds are large scale (over 1 m high in places). Initially, the Ajali Formation was called the White False Bedded Sandstone and later changed to Ajali Sandstone (Reyment, 1965). The Ajali Sandstone is whitish in color with some few siltstone and clay intercalations, and it is extensively exposed with an average exposed height of about 11 m in the study area. It is already weathered on the surface. The thicknesses of the beds are not uniform but have parallel bedding planes which have low dipping beds. The beds consist of friable, moderately sorted sands with shape of grains ranging from subangular to subrounded (Reyment, 1965; Kogbe, 1976).

Petrographic studies of the Ajali Sandstone by Akpofure and Etu-Efeotor (2013a) show the dominant mineral is quartz which is above 95%, with very minimal feldspar in places. The matrix is made up of smaller quartz grains that may have fractured from the larger grains. They also inferred that the Ajali Sandstone may have been indurated initially and due to severe compaction, dissolution, alteration, recrystallization and replacement, have become friable over time.

3. Materials and methods

Outcrop study of the Ajali Sandstones at the various locations was carried out using field equipments such as compass clinometers for measuring the palaeocurrent direction from the cross-beds and rose diagrams were drawn from results. Tape for measuring bed thickness, hammer and sample bags for collecting and bagging samples were some of the materials used. Lithologs of the outcrops were made with the facies stacking pattern observed.

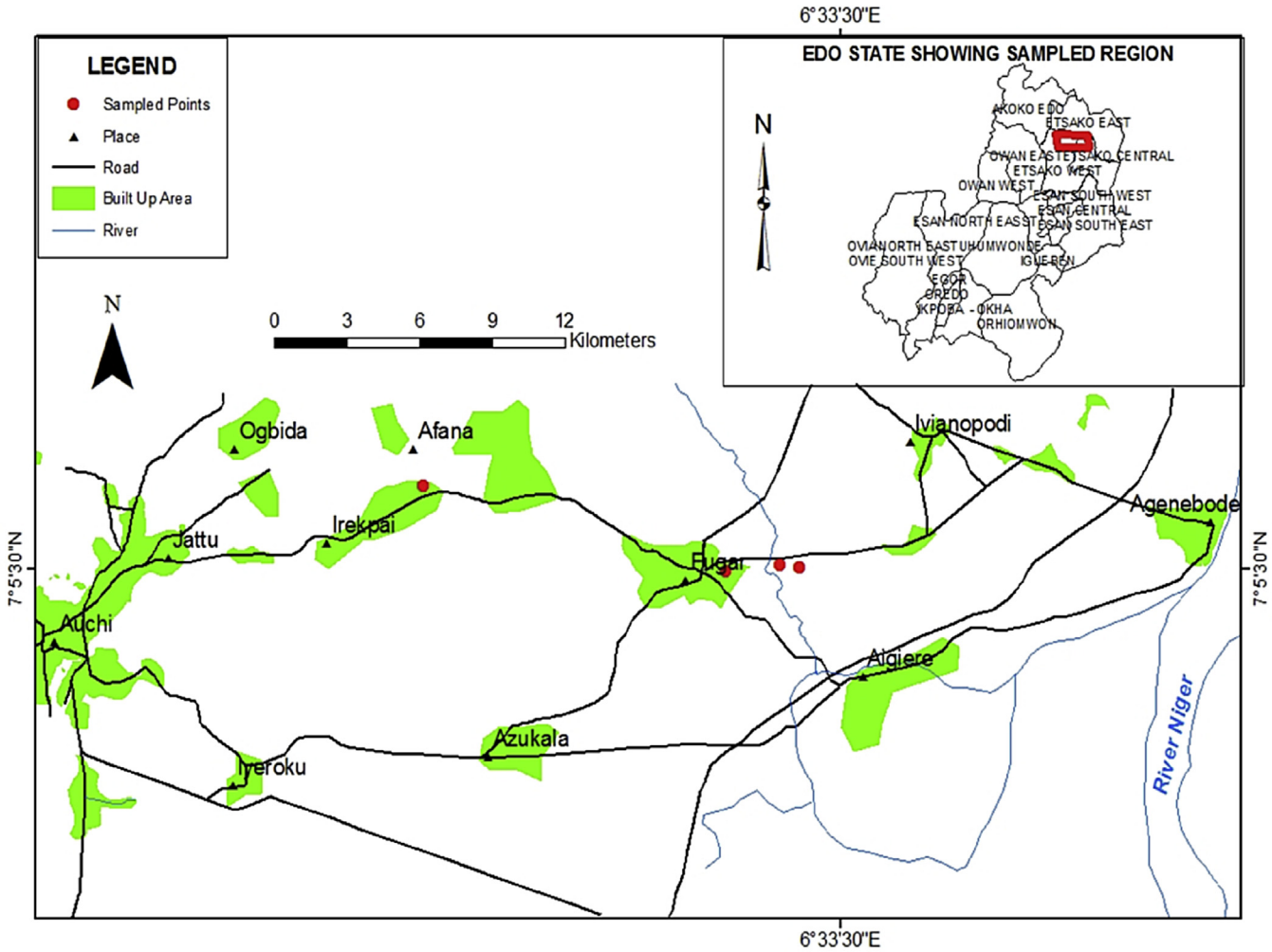

Fig. 1. Location map showing sample points inAyogwiri, Fugar and Orame.