

# The “Yolde Formation”, Upper Benue Trough, N.E. Nigeria-a Critical Look at its Existence

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## Abstract

This paper is intended to raise critical questions on the existence of the Yolde Formation as a lithologic unit in the stratigraphy of the Upper Benue Trough, N.E. Nigeria. Previous authors interpreted the formation as transitional. But how transitional is it? The discussion involved critical analysis of the type section and other identified sections of the formation. Careful appraisal of the previous works shows that both the definition and description of the type section of the formation do not agree. Lower and upper boundaries of the formation were not clearly defined as they did not identify major change in depositional episode. The formation as currently defined contained major shift from continental to marine paleoenvironments. The sediments of the so-call Yolde Formation should be carefully looked at so that it can be grouped properly into its rightful lithologic unit and interpreted with high level of certainty.

**Keywords:** Yolde formation; Type section problem; Upper benue trough

## Introduction

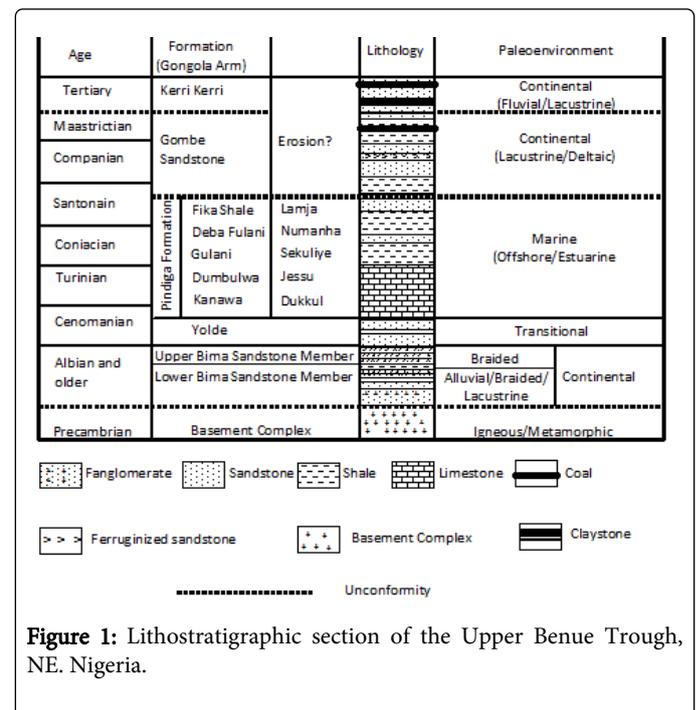
The “Yolde Formation” is presumed by many workers [1-3] to be deposited in a transitional environment i.e.between marine and continental settings. Like the underlying continental Bima Sandstone, the “Yolde Formation” occurs laterally across the length and width of the Upper Benue Trough and has been affected tectonically by the Mid Santonian tectonic episode. As contained in Carter et al. [1], Falconer [4] recognized a transitional group of sediments which he named “passage beds” (the later Yolde Formation of Carter et al. [1]) between Muri Sandstone (now part of Bima Sandstone) and the marine Turonian sediments of Yolde and Muri. Barber et al. [5] and Reymont[6] used a different nomenclature “the transitional beds” but with same implication with Falconer [4] for this unit of sediments.

These studies were conducted when sedimentology was probably at its infant stage and far away from the birth period of sequence stratigraphy and more so the works were on small scale mapping and therefore their resolution were also small. None of these workers had proposed a type section for these transitional sediments. The aim of this article is to high light some problems that are associated with the description and interpretation of the Yolde Formation.

## Problem of the Type Section

There seems to be a little deviation from earlier workers [4-6] by the later authors [1,2] working in the Upper Benue Trough that the “Yolde Formation” was deposited between continental and marine settings, implying that it possess the qualities of both. Carter et al. [1] working on a very small scale regional mapping of the Upper Benue Trough proposed a type section at a stream in Yolde village. He defined the formation as a variable sequence of sandstone and shales which marked the transition from continental to marine sedimentation (Figure 1) and that the base of the formation is defined by the first

appearance of marine shales and the top by the disappearance of sandstone and commencement of limestone-shale deposition.



**Figure 1:** Lithostratigraphic section of the Upper Benue Trough, NE. Nigeria.

By implication, the basal bed of the formation is marine and the marineness is therefore expected to increase upwards through the section/formation and inevitably the disappearing sandstones is also marine.

Carter et al. [1] described the “Yolde Formation’s type section as follows: “the type section occurs in the Dadiya syncline and is exposed in a stream at Yolde where 500ft of sediments are present. In this section the Bima Sandstone is overlain by thinly bedded sandstones

which are followed by alternating sandy mudstones and shelly limestone”.By this description, the basal marine shale which was hitherto designated as marker bed for the formation is missing in the description. The limestone which was designated in the definition as basal part of the overlying unit (Kanawa Member) is included into the “Yolde Formation”.

In all the over five areas where Carter et al. [1] reported the “Yolde Formation”, they concluded that the “passage beds” are poorly exposed. In summary it is clear that neither the base nor the top of the “Yolde Formation” was identified and dully reported. Apart from all the controversies surrounding its type section, the section is nowhere to be seen as either defined or described. How did later workers tie their works to this faulty or even non-existing reference point?

### Problem of Other Sections

Zaborski et al. [2] reported a section of the “Yolde Formation” northeast of RuwanKuka where nearly 150m sediments of the formation are exposed. The lower most part of this section, according to them, contains predominantly gray mudstones which frequently display desiccation cracks, this mudstones are interbedded with feldspathic cross-bedded sandstone, while the upper part consists wholly of cross - bedded, bioturbated and bivalves bearing sandstones. These authors interpreted the lower part of this section as fluvial deposits and the upper part as marine. Similar interpretation of the “Yolde Formation” was made by Abubakar et al. [7] based on elater - bearing pollens from Nasara-1 well. The authors suggested that the Bima Sandstone was deposited in hot arid to semi-arid paleoclimatic condition in the Albian times and this condition prevailed through mid Cenomanian when the “Yolde Formation” was deposited.

Abubakar[3] presented a lithostratigraphic data from Doma stream section in Gombe town in which he showed four intervals of offshore marine shales. This implies that the shoreline has shifted four times at a certain order of transgression and regression. The overlying Kanawa member of the Pindiga Formation has been interpreted as transgressive beds [2,8].

### Discussion

The definition and description of the type section of the “Yolde Formation” by Carter et al. [1] are not consistent with each other and this has led to erroneous interpretations. For example the use of the term “transitional marine” for this group of sediments is highly ambiguous; because:

- The basal beds were well identified as fully marine sediments by Carter et al. [1].
- The upper part of the formation at the RuwanKuka section was interpreted as marine by Zaborski et al. [2].
- Four offshore (deeper) marine intervals were logged by Abubakar[3] towards the upper part of the formation.

The use of this term was probably guided based on plan physiographic settings of marine and continental environments and a transitional environment in between the two ends, neglecting shoreline shift.If the formation represents the first marine incursion into the basin, then it is transgressive, and the lithology will be fining upward, this will reflects general deepening upward trend [9]. The section presented by Abubakar [3] from the Doma stream has demonstrated this deepening trend and he interpreted the formation as a retrograding barrier island–lagoon deposits. This interpretation

has not included the four offshore marine shales reported. Landward barrier migration has been described in terms of barrier overstep and barrier step-up, both producing a shoreface erosion surface (ravinement surface) with an overlying thin sand sheet or storm-ridge sand sheet, depending on the abundance of sand and shoreline history.However, the definition and descriptions of the principal reference section (which should act as reference) by Carter et al. [1], and also Abubakar et al. [7] from Nasara-1 well impliedly showed that the sediments of the “Yolde Formation” were deposited by regressive episodes, because the entire sequence coarsened upwards; shale at the base and sandstone at the top. While Zaborski et al. [2] and Zaborski[8] indicated that the lower part of the “Yolde Formation” was deposited in fluvial setting and the upper part in marine. This interpretation is not in accord with the type section standard as defined and described by Carter et al. [1].

From the sequence stratigraphic point of view, if the underlying Bima Sandstone is fluvial and the lower part of the “Yolde Formation” is also fluvial; then what type of sequence boundary does exist between the two fluvial formations? Except if fluvial can transits into fluvial. Sedimentary formations are supposed to be bounded by important stratigraphic surfaces such as unconformities whose formation is principally controlled by major shift in depositional trend. The lithologic line distinguishing between alluvial and marine portions in the “Yolde Formation” at RuwanKuka and elsewhere as reported by Zaborski et al. [2] and the timeline marking the disappearance of hot to semi-arid paleoclimatic condition in Abubakar et al. [7] could represent major break in the evolution of the Upper Benue Trough. This can be justified in the sense that continental and marine sediments are formed by different processes in different settings and therefore they produce sediments that are obviously different and may genetically have little relationship. A formation should have some degree of lithologic homogeneity as its defining characteristics and may include chemical and mineralogical composition, texture, primary sedimentary structures and fossil content [10]. Major unconformities do not occur within formations.

Another problem with the interpretation of some workers [2,3,7,8] is the occurrence of marine beds at the upper part of the “Yolde Formation” and overlaid by marine Kanawa member, both were interpreted as transgressive deposits. Two assumptions can be made here:

- The two units were formed by single and continuous transgression episode (see Cattaneo and Stell, [9] for conditions of continuous transgression.
- They were form by punctuated transgression episode.

If the first case applies, it means major sequence boundary does not exist between the two units that are genetically related; on the other hand if the transgression was punctuated, then the sequence will be characterized by progradational deposits [9], recording period of regression and then the transgressive Kanawa with an obvious sequence boundary.

### Conclusion

Based on the current assessment, the existence of the Yolde Formation is highly questionable. There are numerous flaws associated with the definition and descriptions of the type section and other sections ascribed to it. There are also numerous inconsistencies in terms of its paleoenvironmental interpretations and designations. This group of sediments should be carefully looked at so that it can be

grouped properly into its rightful lithologic unit and interpreted with high level of certainty.

## References

1. Carter JD, Barber WDF, Tait EA (1963) The geology of parts of Adamawa, Bauchi and Bornu provinces in north-eastern Nigeria. *Bulletin, Geological Survey of Nigeria*, 30.
2. Zaborski PM, Ugodulunwa F, Idornigie A, Nnabo P, Ibe K (1997) Stratigraphy and structure of the Cretaceous Gongola basin NE. Nigeria. *Bulletin centrecherches, Elf exploration production*, 21: 153-185.
3. Abubakar MB (2006) Biostratigraphy, paleoenvironment and organic geochemistry of the Cretaceous sequences of the Gongola basin, Upper Benue Trough, Nigeria, unpublished PhD thesis, AbubakarTafawaBalewa University, Bauchi, Nigeria.
4. Falconer JD (1911) The geology and geography of northern Nigeria., *Universal Journal of Geoscience, Macmillan London* 2: 93-103
5. Barber W, Tait EA, Thompson JH (1954) The geology of the lower Gongola. *Annual Report, Geological Survey, Nigeria* 18-20.
6. Reyment RA (1955) The Cretaceous Ammonites of southern Nigeria and southern Cameroons. *Bulletin Geological Survey, Nigeria* 25.
7. Abubakar MB, Obaje NG, Luterbacher HP, Dike EFC, Ashraf AR (2006) A report on the occurrence of Albian-Cenomanian elater-bearing pollen in Nasara-1 well, Upper Benue Trough, Nigeria: Biostratigraphic and paleoclimatological implications. *Journal of African Earth Sciences* 45: 347-354.
8. Zaborski PM (2003) Guide to the Cretaceous system in the upper part of the Upper Benue Trough, NE, Nigeria. *African Geosciences Review* 10: 13-32.
9. Cattaneo A, Steel RJ (2003) Transgressive deposits: a review of their variability. *Earth Science Review* 62: 187-228.
10. Nichols G (1998) *Sedimentology and Stratigraphy*, Blackwell publishing company, Oxford 355.