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Sequence Stratigraphy of "X" Field in the Coastal Swamp Depobelt of the Niger Delta, Nigeria.

INTRODUCTION

The Niger Delta is a prolific oil province within the West African subcontinent (Fig. 1). The delta is composed of mega units (depobelts), which are shelf-contained entities with respect to stratigraphy, structure-building, and hydrocarbons distribution. It currently produces hydrocarbons from rocks of Eocene-Pliocene age (Fig. 2). Exploration activities have been concentrated in the onshore part of this sequence but as the delta becomes better understood, exploration efforts are gradually being shifted to both the offshore (Pliocene-Pleistocene sections) and the flanks of the delta where cretaceous prospects are encountered. Although the geology, tectonics and evolution of the Eocene-Pliocene sequences of the Niger Delta are fairly well known, these are expected to be refined as new analytical tools, concepts and models evolve. Therefore, it is expected that our knowledge of the Niger Delta shall grow immensely with the application of new and proven concept called ***sequence stratigraphy***. This approach was applied to sedimentary study of the Western Coastal Swamp Depobelt of the Niger Delta using wireline logs (gamma ray and resistivity) of eight wells and high resolution biostratigraphic data of well-"A" and well-"B" (Fig. 4). These Middle Miocene strata were deposited by interaction of subsidence, eustatic changes in sea level and varying sediment supply. Two sequence boundaries and one maximum flooding surface were identified from minimum and maximum faunal abundance and diversity peaks respectively.

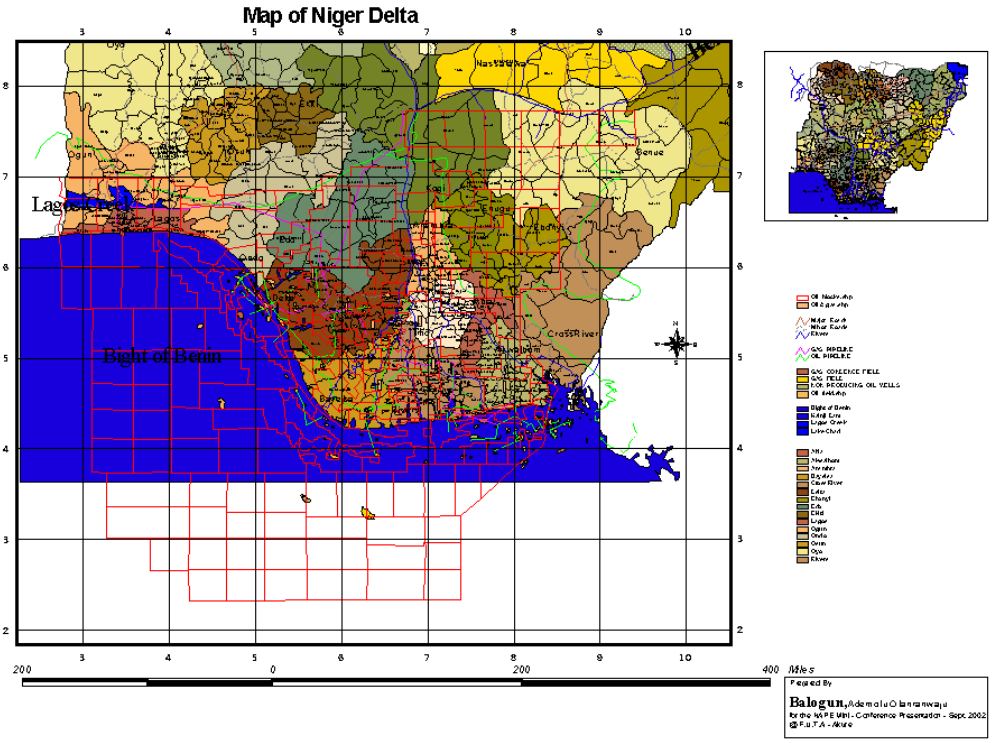

FIG. 1 MAP OF NIGER DELTA, Insert-Map of Nigeria.

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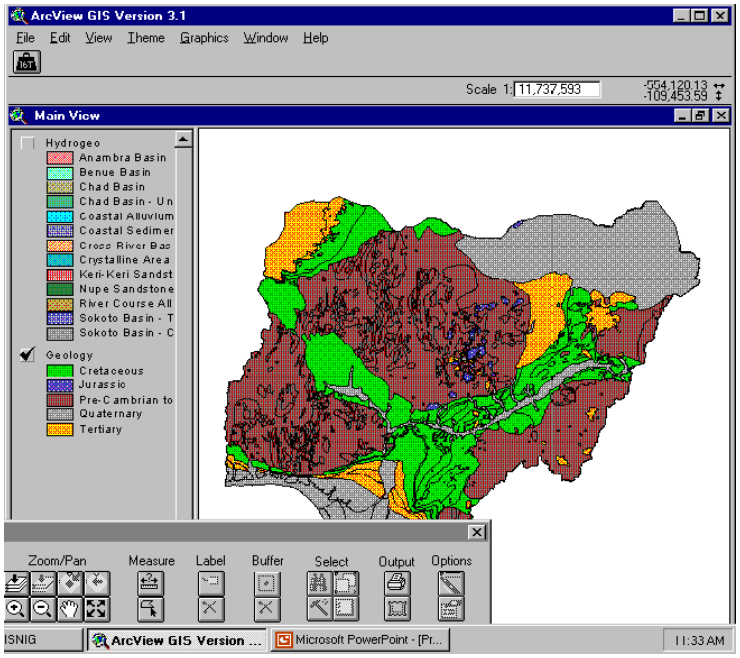

FIG. 2 GEOLOGIC MAP OF NIGERIA.

LOCATION OF STUDY AREA

The area under investigation is the "X" field (Fig. 3). It is located on the onshore part of the Niger Delta. The two wells out of eight studied are exploration wells and have depths of Well-" A" - 3895.3m and Well-" B" -3666.7m.

AIM OF WORK

The aim of this work is to subdivide the stratigraphic column of the "X" field into sequences and systems tracts based on the integration of well logs and high resolution biostratigraphic data available. In order to delineate potential reservoirs, source, and stratigraphic traps.

SCOPE OF WORK

The present work covers the following: -

- -- Interpretation of lithology using Gamma ray log.
- -- Identification of sequence boundaries using Gamma ray and biostratigraphic data.
- -- Identification of condensed sections where possible maximum flooding surfaces as indicated on well logs and biostratigraphic data.
- -- Identification of well logs responses that characterize the different systems tracts from well logs and
- -- Correlation of wells in the study area.

BIOSTRATIGRAPHIC DATA

High-resolution biostratigraphic data was provided for wells "A" and "B" was used (Fig. 5). Based on the faunal abundance and diversity peaks, maximum flooding surfaces were picked. Also the microfaunal zonation table of well A indicates Bolivina 25 and Chiloguembelina 3 as marker species representing a maximum flooding surface. Faunal diversity minima were used to pick sequence boundaries.

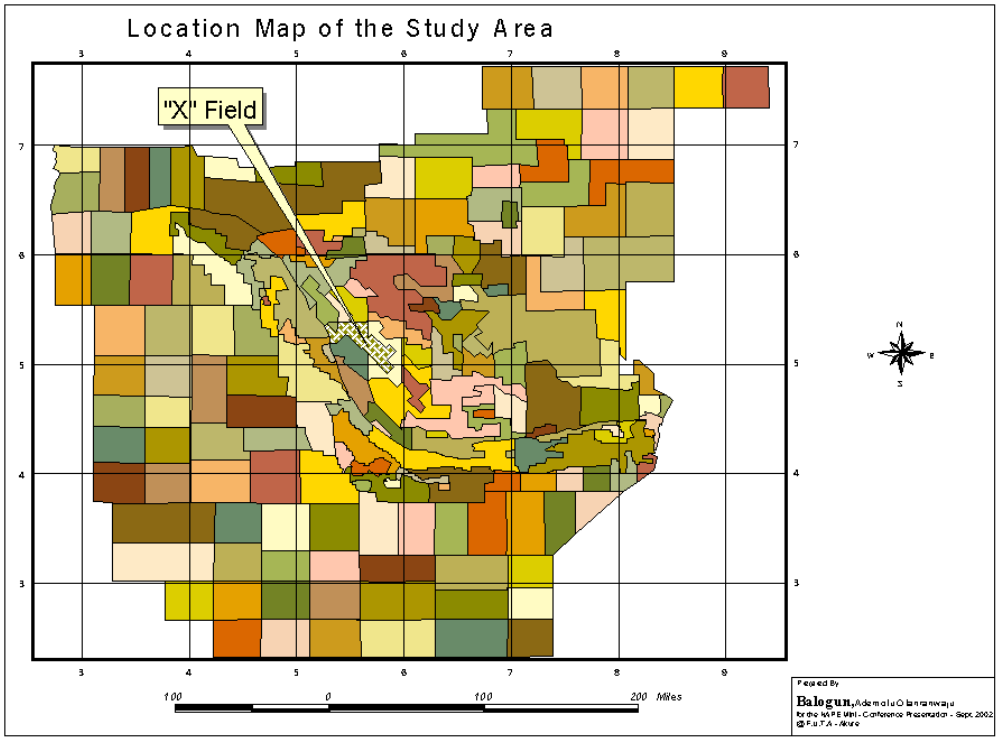

FIG. 3 LOCATION MAP OF THE STUDY AREA, Showing "X" Field.

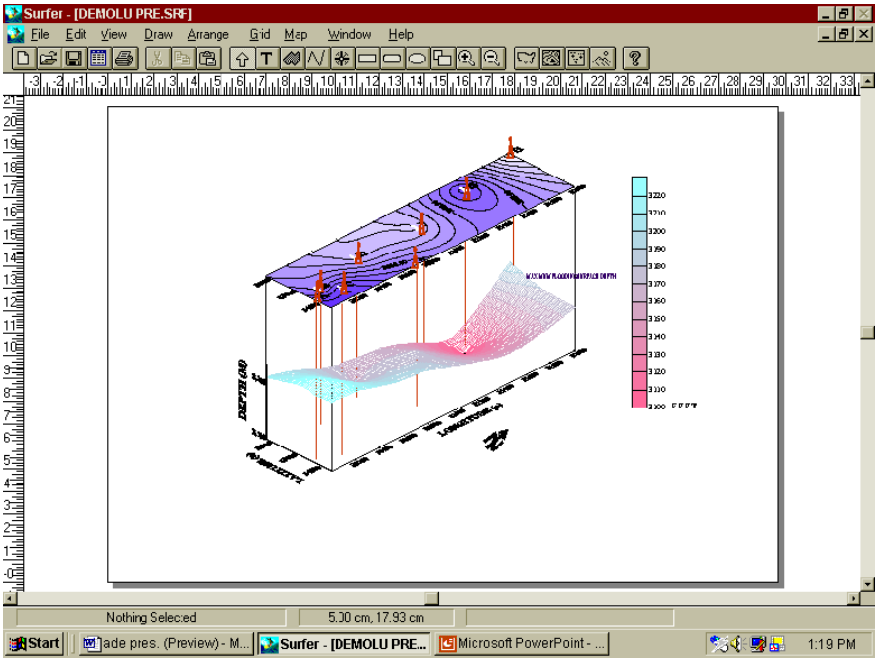

FIG. 4 DIGITAL ELEVATION MODEL (DEM) OF THE STUDY AREA, Showing distribution of the 8-Wells within the Field.

Top Depth (m)	base Depth(m)	Zone Type	Zone Code	Quality	Remarks	Last update
0	6010	F	F9520	3		1993-04-13
5350	5530	F	F9505	3	Top Nonion 6	1993-04-13
5590	5950	F	F9503	3	Top Bolivina 25	1993-04-13
6009	8170	F	F9501	3	Top Chiloguembelina 3	1993-04-13
8230	9130	F	F9305	4	Peak Abundance	1993-04-13
9190	10930	F	F9303	4	Peak Abundance	1993-04-13
10990	12030	F	F9301	3	Top Alabammina 2	1993-04-13

Top Depth (m)	base Depth (m)	Zone Type	Zone Code	Quality	Remarks	Last update
0	5340	F	F`9540	3	Bol. 25 & Uvigerina 5	1988-09-12
0	5740	F	F9520	3	Chiloguembelina 3	1988-09-12
4975	6165	F	F9500	1	Top Cassigerinella – 1	1988-09-12
6220	8457	F	F9300/F9500			1988-09-12
8460	12780	F	F9300	2	Occ. of Bolivina 25A	1988-09-12

FIG. 5. BIOSTRATIGRAPHIC DATA OF WELL-A & -B.

SYSTEMS TRACTS

The strata in the study area are divided into basin floor fan and prograding wedge of the lowstand, transgressive and highstand systems tracts. Biostratigraphic data reveal that these sediments were deposited in inner neritic to bathyal marine environments. Reservoir characterization shows the sand distribution for each systems tract. The massive sand formation of the basin floor fan, the sand-rich prograding wedge and the highstand sands constitute good (potential) reservoirs. The distal shale toes of the prograding wedge and transgressive shales form seals for the (potential) stratigraphic traps formed in the study area (Fig. 6, 7 & 8).

EXPLORATION IMPLICATIONS

The determination of the types of systems tracts present and the identification of systems tracts associated with hydrocarbon reservoirs, seals and source rocks are led by sequence stratigraphy. The morphology and importance of reservoirs and seals vary greatly between systems tracts.

The development of excellent reservoir sands and the shales of the upper transgressive systems tract form seals that are good at least on the outer shelf characterize the highstand systems tract. The alternation of highstand systems tracts and transgressive systems tracts sands and shales respectively provides a union of reservoir and seal rocks that is essential for hydrocarbon accumulation and stratigraphic trapping.

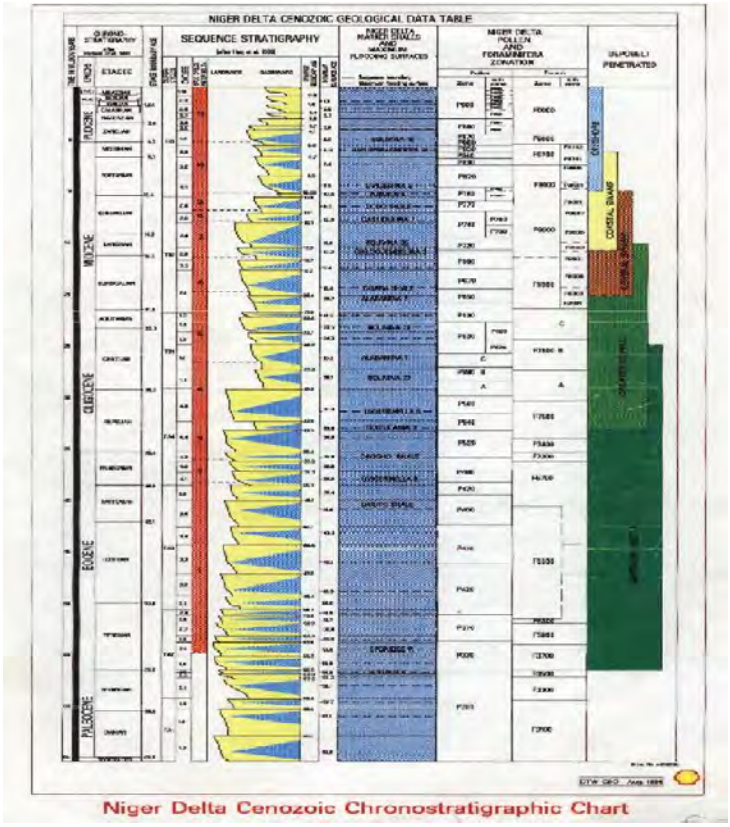

FIG. 6 NIGER DELTA CENOZOIC CHRONOSTRATIGRAPHIC CHART.

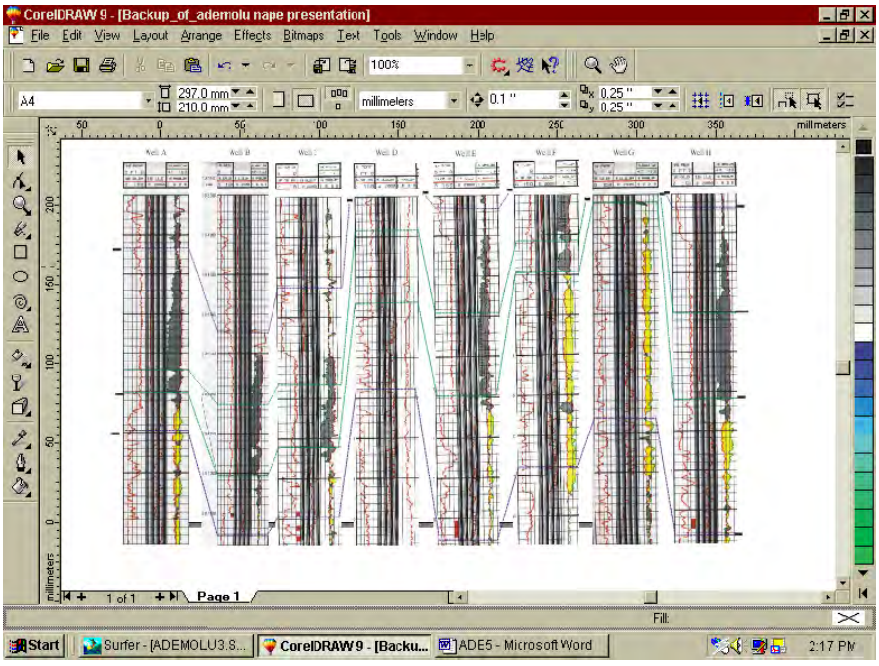

FIG. 7: 2-D CORRELATION PROFILE OF 8-WELLS IN THE STUDY AREA.

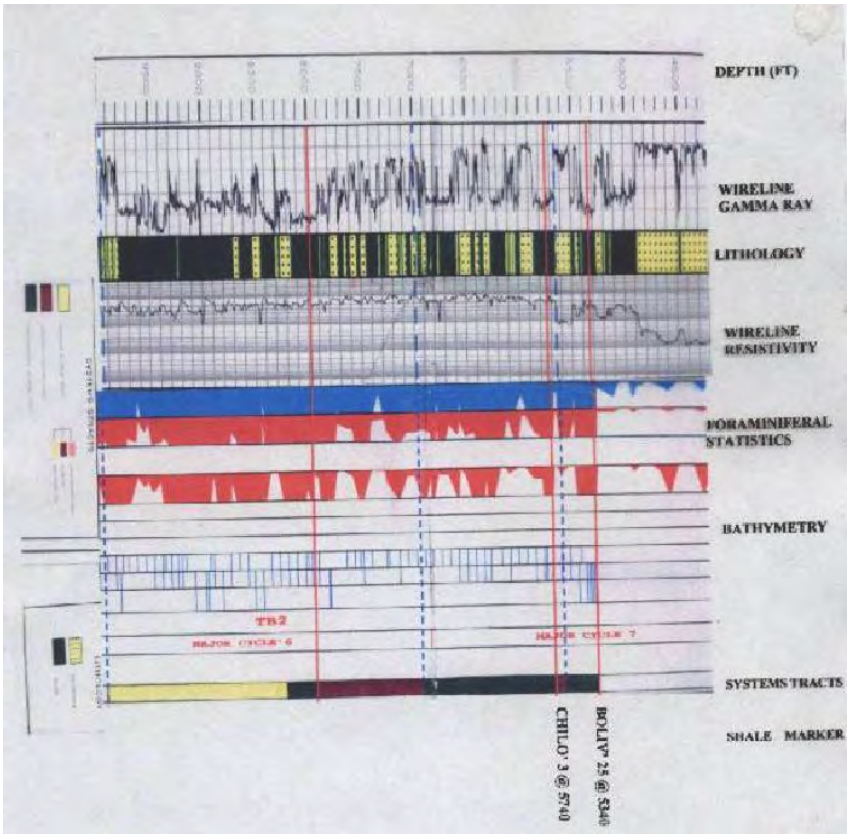

FIG. 8: LITHOLOGIC & BIOSTRATIGRAPHIC CHART OF WELL-A, Showing the different System Tracts.

The sands within the prograding wedge have good reservoir properties which on being sealed by the transgressive shales creating potential stratigraphic traps.

This concept helps to improve the ability of exploration team to locate subtle but potentially profitable stratigraphic traps and also to increase reserves.