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Application of seismic stratigraphy and structural analysis in the determination of petroleum plays within the Eastern Niger Delta Basin, Nigeria

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Abstract As Nigerian operations expand into more challenging and costly operating environments of deep-frontiers, there is need for critical access to sound stratigraphic, depositional and reservoir facies models. The extraction of facies types from geometric insights and pattern recognition using predominantly 3D seismic data is a rapidly evolving discipline that facilitates the development of reservoir prediction models linked to significant plays. Play based exploration approach such as this provides the critical link between regional observations and prospect generation. In this study a regional dataset which comprised of a merged 3D seismic volume, well logs, biostratigraphic, biofacies, paleobathymetry and core data from Eastern Niger Delta was interpreted. Results clearly show the overall structural, stratigraphic and architectural styles within the region to ensure that successes achieved in the past can be repeated and also significant advances made to ensure future exploration success. An added outcome is a low-risk exploration workflow that is capable of correctly predicting reservoir rocks to be encountered in a new play and prospect. Three plays have been identified from this study: (1) shelf edge deltas, (2) pinch-out play and (3) hanging wall play. Each play displays a unique morphology, seismic expression, structural configuration, migration pathway, seal integrity and reservoir dispersal pattern. These prediction models provide play based exploration targets for areas with similar depositional settings. The successful application of this technique serve to encourage exploration in the Niger Delta Basin by adopting strategies where seismic stratigraphy will be the most likely means to provide drilling targets to more independent operators.

Keywords Seismic stratigraphy · Structural configuration · Pattern recognition · Petroleum plays

Introduction

The financially, geologically and most attractive petroleum play area in Nigeria today exists in the onshore and offshore Niger Delta region which forms one of the world's major hydrocarbon provinces. Its estimated oil and gas reserves are huge, available technology is constantly improving and a large infra-structure system is available. The exploration of this province has taken place almost exclusively during the past 45 years. The remaining opportunities in the Niger Delta area are mostly either small, shallow, normally pressured but well-imaged targets, or potentially larger, deeper, over pressured and poorly imaged targets (Adereti et al. 2012). Prospecting for deeper targets requires play based prediction models that can be applied to augment the interpretation of poorly-imaged targets.

As Nigerian operations expand into more challenging and costly operating environments, there is need for critical access to sound stratigraphic, depositional and reservoir facies models. One approach to developing these models is through the study of Eocene to Recent systems as analogs for subsurface systems. This paper describes a study of an Upper Oligocene to Eocene sediments between two oil

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