

Static Reservoir Modeling Using Well Log and 3-D Seismic Data in a KN Field, Offshore Niger Delta, Nigeria

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ABSTRACT

This study focuses on the application of 3D static model using 3-D seismic and well log data for proper optimization and development of hydrocarbon potential in KN field of Niger Delta Province. 3D Seismic data were used to generate the input interpreted horizon grids and fault polygons. The horizon which cut across the six wells was used for the analysis and detailed petrophysical analysis was carried out. Structural and property modeling (net to gross, porosity, permeability, water saturation and facies) were distributed stochastically within the constructed 3D grid using Sequential Gaussian Simulation and Sequential Indicator Simulation algorithms. The reservoir structural model show system of different oriented growth faults F1 to F6. Faults 1 and Fault 4 are the major growth faults, dipping towards south-west and are quite extensive. A rollover anticline formed as a result of deformation of the sediments deposited on the downthrown block of fault F1. The other faults (2, 3, 5 and 6) are minor fault (synthetic and antithetic). The trapping mechanism is a fault assisted anticlinal closure. Results from well log analysis and petrophysical models classified sand 9 reservoir as a moderate to good reservoir in terms of facies, with good porosity, permeability, moderate net to gross and low water saturation. The volumetric calculation of modeled sand 9 horizon reveals that the (STOIIP) value at the Downthrown and Ramp segment are 15.7 MMbbl and 3.8 MMbbl respectively. This implies that the mapped horizon indicates hydrocarbon accumulation in economic quantity. This study has also demonstrated the effectiveness of 3-D static modeling technique as a tool for better understanding of spatial distribution of discrete and continuous reservoir properties, hence, has provided a framework for future prediction of reservoir performance and production behavior of sand 9 reservoir. However, more horizontal wells should be drilled to enhance optimization of the reservoir.

KEYWORDS

Porosity; Permeability; Water Saturation; Volumetric Calculation; Facies

1. Introduction

The increasing demand for petroleum products has posed a change to the search of oil and gas. This search for hydrocarbon has developed increase with advances in greater computational technology to evaluate the probability of hydrocarbon proneness of the basin thereby limiting the risk factor associated with hydrocarbon. Government revenue of most oil producing countries in the world depends on these products. In Nigeria, Niger Delta province has commercial accumulation of oil and gas.

The production of oil and gas is from the accumulation in the pore spaces of reservoir rock usually sandstone, limestone or dolomite. In Niger Delta, petroleum production is produced in sandstone and unconsolidated sand of Agbada formation. This formation is characterized by alternating sandstones and shale with rock units varying in thickness from 100 ft to 15000 ft [1]. The sand in this formation is mainly hydrocarbon reservoir with shale providing lateral and vertical seals [2]. The Niger Delta is situated in the Gulf of Guinea between the longitude 5°E - 8°E and Latitude 3°N - 6°N. The Niger Delta lo-

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Reservoir quality controls and reservoir modelling of continental to transitional shallow marine sedimentary basins of Southern Nigeria Adamolekun, Olajide Jonathan, 2023-06-05 The object based stochastic approach in facies modelling is important in the construction of geologically consistent 3 D reservoir models and in constraining the distribution of petrophysical properties Tortuosity factor facies porosity and cementation factor constitute major uncertainties in the generated 3 D static model of the Niger Delta Basin Reservoir quality in the Dahomey Basin is mainly controlled by detrital matrix carbonate cement and iron oxide and iron oxyhydroxide cements *Tight Oil Reservoirs* Hadi Belhaj, 2023-01-21 Tight Oil Reservoirs Characterization Modeling and Field Development the latest release in the Unconventional Reservoir Engineering Series delivers a full spectrum of reservoir engineering guidelines so that the engineer can focus on every stage of development specific to tight oil Covering characterization micro and nano scale modeling drilling horizontally completing hydraulic fracturing and field development each section includes case studies practice exercises and future references for even deeper understanding Rounding out with coverage on field economics and remaining challenges this book puts control in the engineer s hands In this ongoing series each release will discuss the latest resources explain their importance in the market show the benefits of the resource through the latest research provide details and protocols on how to evaluate and develop the resource and give case studies and practice questions to gain practicality Supports the petroleum engineer with a structured table of contents focused on one unconventional resource making research and solutions easier to find Covers the full spectrum of reservoir engineering including modern research development field application and environmental considerations Applies practicality with case studies exercises and references included in every chapter **Sediment-Body Geometry and Heterogeneity** A.W. Martinius, J.A. Howell ,T. Good ,2014-07-28 Over the past 20 years there has been a major growth in efforts to quantify the geometry and dimensions of sediment bodies from analogues to provide quantitative input to geological models The aim of this volume is to examine the current state of the art from both an industry and an academic perspective Contributions discuss the challenges of extracting relevant data from different types of sedimentary analogue outcrop process models seismic and the application and significance of such information for improving predictions from subsurface static and dynamic models Special attention is given to modelling reservoir properties and gridding issues for predicting subsurface fluid flow As such the volume is expected to be of interest to both the geoscience community concerned with the fundamentals of sedimentary architecture as well as geological modellers and engineers interested in how these characteristics are modelled and influence subsurface predictions *Sedimentary Processes* Gemma Aiello, 2020-05-27 This book contains six chapters covering the sedimentary processes with examples from Asia Turkey and Nigeria The book focuses on the geological characteristics beach processes coastal and lacustrine sedimentary archives and the role of mangroves in controlling coastal sedimentation In more detail these topics are pertaining to the geological

characteristics and the production response of a reservoir located offshore the Niger Delta Nigeria the coastal lacustrine geo archives with the example of the Lake Bafa Turkey the sedimentary processes in the riparian zone of the Ruxi Tributary Channel Three Gorges Reservoir China the beach morphological changes studied by means of a contour line change model and finally the role of the mangroves in controlling the sedimentary accretion of coastal and marine environments with the regional example of the south eastern Asia *Anatomy of a Giant Carbonate Reservoir* Stephen C. Ruppel ,2013-02-20 Hardcover plus DVD [SPE Reservoir Evaluation & Engineering](#) ,2008 **Rock Mechanics: Meeting Society's Challenges and Demands, Two Volume Set** Erik Eberhardt,Doug Stead, Tom Morrison,2007-05-17 Ore extraction through surface and underground mining continues to involve deeper excavations in more complex rock mass conditions Communities and infrastructure are increasingly exposed to rock slope hazards as they expand further into rugged mountainous terrains Volume 1 presents papers describing new technologies ideas and insights concerning fundamental rock mechanics while the second volume comprises a collection of rock engineering case histories relevant to the major themes of the symposium rock slope hazards geotechnical infrastructure surface and underground mining and petroleum exploitation *Paleozoic Stratigraphy and Resources of the Michigan Basin* G. Michael Grammer,William B. Harrison III,David A. Barnes,2018-04-12 The Michigan Basin is a classic intracratonic basin that has played a significant role in the fundamental understanding of geological processes in such basins and has been an important resource for oil and gas economic minerals groundwater and coal Despite the classic nature of the Michigan Basin there has not been a special volume dedicated to the basin in nearly 25 years Since that time new advancements in the geological sciences particularly the utilization of high resolution sequence stratigraphy and three dimensional geostatistical modeling have led to a new and more comprehensive understanding of the Paleozoic sedimentary packages of the Michigan Basin This volume provides significant new insights of the Michigan Basin to both academic and applied geoscientists it includes papers that discuss various aspects of the sedimentology and stratigraphy of key units within the basin as well as papers that analyze the diverse distribution of natural resources present in this basin **Geophysics and Geosequestration** Thomas L. Davis,Martin Landrø,Malcolm Wilson,2019-05-09 An overview of the geophysical techniques and analysis methods for monitoring subsurface carbon dioxide storage for researchers and industry practitioners *Seismic Amplitude Versus Offset Analysis and Amplitude Inversion Theory and Practice—A Comprehensive Review* Hüseyin Özdemir,2026-03-21 This book provides an extensive critical review of seismic inversion methods and applications Hydrocarbon reservoir extensions and properties cannot be accurately defined from information provided by geological data geophysical data and well log data Seismic data has adequate spatial coverage but lacks vertical resolution while well data has excellent vertical resolution but spatially sparse Seismic reflection amplitudes are related to pore fill and lithology changes Seismic AVO analysis and inversion exploit variation of amplitudes with angle of incidence to derive useful attributes and elastic rock properties such as velocity impedance and density Seismic inversion

attempts to fill the gap between and away from the already drilled wells with rock properties that are available from the measured and or interpreted well log data In this endeavour seismic data well log data and all available geological model data are integrated to predict rock and ultimately reservoir properties such as porosity water saturation shale content brittleness and pore pressure This book is aimed at graduate and postgraduate students academics and geoscientist exploiting earth resources It is especially directed to oil and gas industry professionals in supporting their efforts in quantitative reservoir description from seismic data While brief theoretical derivations are provided to understand power and limitations of inversion methods used emphasis has been on the practical applications A comprehensive critical review of the seismic inversion and AVO theory and applications published and presented at technical meetings is provided with ample references and further references for probing geoscientists AAPG ... Annual Convention ,2003 Issue for 2000 includes also the abstracts of papers presented in a separately paged section *AAPG Explorer* American Association of Petroleum Geologists,1998 The Leading Edge ,2009 **International Petroleum Conference & Exhibition of Mexico** ,1994 *GeoArabia* ,2008 **International Petroleum Encyclopedia** ,1997 Petroleum Abstracts ,1996 **Transactions of the SPWLA ... Annual Logging Symposium** Society of Professional Well Log Analysts,2004 **Transactions** Gulf Coast Association of Geological Societies,2009 **Journal of Petroleum Technology** ,2006-07

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