**ANALYSIS OF TIME-LAPSE SEISMIC DATA USING ROCK PHYSICS MODELS AND**

**SIMULATIONS IN UDAM FIELD IN NIGER DELTA, NIGERIA.**

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**NNAMDI AZIKWE UNIVERSITY AWKA.**

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**SUPERVISORS; PROF**. **A.G ONWUEMESI**

**DR., E. K. ANAKWUBA**

**OCTOBER, 2016**

**APPROVAL**

This dissertation titled Analysis of Time-lapse Seismic Data using Rock Physics Models and

Simulations in Udam Field in Niger Delta, Nigeria, was carried out by **Aniwetalu Emmanuel Ude** with **registration No. 2012507005** and submitted to Department of Geology Falculty of Physical Sciences, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

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This dissertation is an original research work of **Aniwetalu Emmanuel** with registration number **2012507005F,** Department of Geology, Faculty of Physical Sciences, Nnamdi Azikiwe University, Awka. No part of this dissertation has been presented for a degree or diploma award in this university or elsewhere

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**DEDICATION**

This dissertation is dedicated to the Almighty God and to my precious wife Aniwetalu Nneamaka Juliet who is always there for me.

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**Aniwetalu Emmanuel Ude**

**ABSTRACT**

Time-lapse seismic data were analysed using rock physics models and simulations, to image the static and dynamic reservoir fluid flows which result from production related changes and enhanced oil recovery (EOR) programme in Udam Field, Onshore Niger Delta. Fluid replacement and velocity depth models were simulated to provide wider coverage on the behaviour of the attributes and velocity distributions. Rock physics modelling was achieved through attribute cross-plotting, probabilistic neural network, acoustic impedance inversion and elastic impedance inversion. Fluid replacement modelling shows that the initial average porosity and water saturations prior to steam injection program are 29.30% and 17.50% respectively while porosity and water saturations increased to 36% and 28.33 % respectively as production progresses due to production related effects or steam injection programme. The simulation results revealed the effects of pressure, temperature, and salinity on the reservoir pore fluids in the replacement zone. It shows that oil velocity, oil density and oil modulus increase with increasing pressure and decrease with increasing temperature due to dissolved gas. The result revealed that gas saturations and their thicknesses in the field range from 50 – 68% and 45 – 90m respectively. The result of crossplot of the well-derived rock properties shows that density, acoustic impedance, and Lambda-Rho attributes were more sensitive to fluids and lithology discriminations. The discrimination strength of the density attributes were shown in the probabilistic neural network, which presents density attributes on every common depth point of the seismic data and distinguished the possible hydrocarbon reservoir zones in undrilled areas of the field. The model based acoustic impedance inversion revealed the reservoir fluid flow patterns and by-passed hydrocarbon zones in the SW and NE parts of Udam field. The zones represent target areas to spud additional wells. The effects of production related changes were revealed by velocity anisotropy, velocity depth modelling and elastic impedance inversion. The results show high and low velocity anisotropy in shale and sand respectively. The result revealed that velocities did not follow regular pattern of velocity increase with depth due to increase in porosity caused by fracturing of the pore spaces. The elastic impedance inversions revealed the drainage patterns, stress variations which indicate SE-NW stress orientation and similar pattern of injection program in Udam Field.

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