Cairo University

3D MECHANICAL EARTH MODEL FOR OPTIMIZED WELLBORE STABILITY
A CASE STUDY FROM SOUTH OF IRAQ

By

Hayder Lazim Abdulridha

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Petroleum Engineering

FACULTY OF ENGINEERING, CAIRO UNIVERSITY

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Under the Supervision of

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Title of Thesis:

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Key Words:
Geomechanics, Wellbore stability, MEM, Well trajectory, Uncertainty analysis

Summary:
Offset data of eleven wells are investigated in detail to determine the rock properties and stresses to construct a one-dimensional mechanical earth model (1DMEM). 1DMEMs are integrated to build a three-dimensional model to characterize the field geomechanical parameters. Besides, uncertainty analysis and history matching are executed on the inputs and outputs, respectively.

DISCLAIMER

I hereby declare that this thesis is my own original work and that no part of it has been submitted for a degree qualification at any other university or institute.

I further declare that I have appropriately acknowledged all sources used and have cited them in the reference section.

Name: Hayder Lazim Abdulridha Date:
Signature:

DEDICATION

O Allah, this humble work is a sign of my endless thanks to you and deep appreciation to those you made them part of my life!

To my father and mother for their unconditional love and care that cannot be quantified.

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Nomenclatures

Acronym	Definition	Acronym	Definition
1DMEM	One-dimension mechanical earth model	3DMEM	Three-dimension mechanical earth model
BPC	Basra petroleum company	BS	Bit size, inch
CALI	Caliper log, inch	C_o, UCS	Shear strength
DTC, DT, ΔTC	Compression sonic slowness, μs/ft	DTSM, ΔTS	Shear wave slowness, μs/ft
FMI	Formation Micro Imager log	GR	Gamma-ray log, dega
INOC	Iraqi National Oil Company	MCS	Monte Carlo Simulation
MDT	Modular dynamic formation tester	M_W	Mud weight
PHIE, $\emptyset$	Effective porosity	PHIT, ϕ	Total porosity
P_p	Pore pressure	P_w	Wellbore pressure
QRA	Quantitative Risk Assessment	RHOZ, ρ_b	Bulk density, g/cm3
ROO	Rumaila Operating Organization	S_1	Maximum principal stress
S_2	Intermediate principal stress	S_3	Minimum principal stress
S_o	Cohesion	UBI	Ultrasonic Borehole Imager
WBO	Breakout width, deg	θ	azimuth clockwise from the σ_H
σ'	Effective stress	σ_a, σ_z	Axial stress
σ_r	Radial stress	σ_θ	Tangential stress
σ_H	Maximum horizontal stress	σ_h	Minimum horizontal stress
ϕ, FANG	Internal friction angle, degrees	σ_V	Vertical principal stress