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4D SEISMIC FEASIBILITY STUDY, IN SIENNA, WEST DELTA DEEP MARINE, OIL FILED

A thesis submitted for partial fulfillment for the requirements of Master degree of Science in Applied Geophysics

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Note

The present thesis is submitted to faculty of Science, Ain Shams University in partial fulfillment for the requirements of the Master degree of Science in Geophysics.

Beside the research work materialized in this thesis, the candidate has attended ten post-graduate courses for one year in the following topics:

1. Geophysical field measurements
2. Numerical analysis and computer programming
3. Elastic wave theory
4. Seismic data acquisition
5. Seismic data processing
6. Seismic data interpretation
7. Seismology
8. Engineering seismology
9. Deep seismic sounding
10. Structure of the earth

He successfully passed the final examinations in these course.

In fulfillment of the language requirement of the degree, he also passed the final examination of a course in the English language.

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Abstract

4D (time-lapse) seismic has become a powerful technology for oil companies to manage their reservoirs. The use of 4D technology is obviously a major investment for oil companies. time-lapse seismic has been proven to be very effective for monitoring not only gas production but also injection process. The process of gas production causes variations in reservoir parameters such as fluid types, fluid saturation and pressure and reservoir thickness and thus changes seismic properties of saturated reservoir rock. Therefore, it is crucial to the success of 4D seismic projects to make a feasibility study determining how we can properly plan 4D seismic surveys for a reservoir under consideration.

Determining the petrophysical parameters (porosity,effective porosity, hydrocarbon and water saturation, shale content)for sienna reservoirs rocks using conventional logging tools(Gamma ray,Density,Neutron, Resistivity) in two wells and study of the lithology and clay mineralogy of sienna reservoir through Thorium ,photo electric effect, potassium, neutron-density and photo electric effect-density crossplots was done.

AVO simultaneous inversion inverts pre-stack seismic into P-wave velocity (Vp), S-wave velocity (Vs) and density (ρ). The products of AVO simultaneous inversion can be modeled in the static 2D models.

The rock physics model can explain variations in reservoir parameters using the changes in seismic properties several theories link seismic properties of reservoir rock to pore spaces, pore fluids, effective pressure and other reservoir parameters. It is primarily based on core measurements and well logs (1D point model) and AVO inversion product (2D model). The fluid substitution model used to detect the change of the water saturation in the seismic parameters using Gassmann’s equation and the friable sand model used to detect the change of the pore pressure in the seismic parameters using the Hertz-Mindlin and lower Hashin-Shtrikamn equation.

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List of Abbreviations

Abbreviation	Name
TCF	Trillion cubic feet
WDDM	WEST Delta Deep Marine
NDOA	Nile Delta offshore anticline
3D	Three Dimensional
2D	Two Dimensional
AVO	Amplitude Versus Offset
MD	Measured depth
TVD	True vertical depth
TVDss	True vertical depth sub sea
TWT	Two Way Time
Vp	P-wave velocity
Vs	S-wave velocity
Vp/Vs	Ratio of P-wave velocity to S-wave velocity
Vsh	Shale Volume
Rp	P-wave Reflectivity
Rs	S-wave Reflectivity
Zp	P-wave impedance
Zs	S-wave impedance
Φ	Porosity
FT	Formation Temperature
GR	Gamma Ray
GDT	Gas Down To
GWC	Gas Water Contact
HPVH	Hydrocarbon Pore Volume Thickness
RM	Resistivity of mud
RMC	Resistivity of mud cake
RMF	Resistivity of mud filtrate
Rw	Water Resistivity
φ	Porosity
Sw	Water saturation
SCAL	Special core analysis
K	Bulk modulus
μ	Shear modulus
Tp	Transmitted P-wave
Ts	Transmitted s-wave
θ	Angle of incidence