

Ain Shams University
Faculty of Science
Geophysics Department



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

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By

Ahmed Ezzat Mohamed

B.Sc. in Geophysics

Faculty of Science – Ain Shams University, 2010

To

Geophysics Department

Faculty of Science

Ain Shams University

Supervised by

Prof. Dr. Abd Elnaser Mohamed Helal

Professor of Geophysics

Geophysics department – Faculty of Science – Ain Shams University

Dr. Samir Elnaggar

Assistant Chairman for Exploration
And Board Member of El Mansoura
Petroleum Company

Dr. Ayman Shebl

Lecturer of Geophysics
Geophysics department – Faculty
of Science – Ain Shams University

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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.

Prof. Dr. Said Abdel-Maaboud Aly

Head of Geophysics Department

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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 (V_p), S-wave velocity (V_s) 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 |