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Estimation of Pore Pressure Regime - Bentiu1 Formation - A Sudanese reservoir

تحديد نظام تدرج الضغط - طبقة بانتيو 1 – مكمن سوداني

A THESIS SUBMITTED IN PARTIAL FULFILMENTS FOR THE DEGREE OF M.SC IN PETROLEUM ENGINEERING

(DRILLING ENGINEERING)

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October, 2012

بسم الله الرحمن الرحيم
قل يا عبادي الذين أسرفوا على أنفسهم لا تقنطوا من رحمة الله إن الله يغفر الذنوب جميعا إنه هو الغفور الرحيم
قُلْ يَٰعِبَادِيَ ٱلَّذِينَ أَسْرَفُوا۟ عَلَىٰٓ أَنفُسِهِمْ لَا تَقْنَطُوا۟ ٥٣
مِن رَّحْمَةِ ٱللَّهِ ۚ إِنَّ ٱللَّهَ يَغْفِرُ ٱلذُّنُوبَ جَمِيعًا ۚ إِنَّهُۥ هُوَ ٱلْغَفُورُ ٱلرَّحِيمُ
صدق الله العظيم
(سورة الزمر)

Dedication

I would like to dedicate this thesis to Lovely & Kindly hearts who support me along all my life:

My Mum & Dad

, Husband

, Son

, Small Family, Big Family

& friends

Acknowledgements

In the name of Allah the Most Gracious, the Most Merciful

First and foremost, I would like to thank my Creator for giving me a still functioning body and mind in order to live life and learn, and particularly to work on my dissertation project, hereby completing my Master's studies.

I give my high, respectful gratitude to my supervisor Dr. Ahmed Abdel Aziz for his great assistance and support during this thesis project.

Great endless thanks to Dr. Tagwa Musa for her useful guidance, efforts, suggestions, and without her help this work would be less useful and less complete.

ABSTRACT

This research provides a practical simple numerical equation for estimating pore/formation pressure in “Bentiu-1 formation - Bamboo West field”. The base of the work is the ratio between the pressure (P), Bulk density (ρ), Depth (h) and the acceleration gravity (g), where the terms (ρ) and (h) represented by: Deep resistivity , Sonic and Bulk density logs data.

Two different numerical methods were used to generate the final equation and “Error Analysis” was done to compare between them and reach the best model. Then “Surfer-8” software was used to create the pore pressure distribution contour map of the study area.

This method can be applied during the early life of proposed oil field to give an initial prospective of how much pressure distribution could be within any formation since the field has no enough data for using other methods. Also this new method will safe cost and times and considered as a huge and real plus to oil industry in Sudan for the best sake and development of our own country.

The study show that both sonic and resistivity log data can be used to estimate the pore pressure for this formation with 1.13% and 1.16%, respectively, using mean absolute percentage error (MAPE). And the calculated pressure distribution contour maps for both Sonic and Resistivity equations, using Surfer software, are look similar to those plotted for the real pressure in Bentiu-1 formation.

التجريد

تم في هذا البحث إيجاد معادلة رياضية عملية و بسيطة لتقدير الضغط الطبقي لطبقة بانتيو-1 بحقل بامبو غرب النفطي. أساس هذا العمل هو العلاقة التي تحسب قيمة الضغط إعتمادا على:عجلة الجاذبية الأرضية ((g، الكثافة ρ)) والعمق(h) . حيث تم تعويض كل من الكثافة والعمق كدوال في بعض تسجيلات الآبار وهي:تسجيلات المقاومة((Re ، تسجيلات الصوت ((Dt والكثافة (ρ).

تم إستخدام طريقتين حسابيتين لإيجاد المعادلة ومن ثم حساب قيمة الخطأ بغرض الحصول على أفضل معادلة. وبعد ذلك تم رسم خرائط توزيع الضغط الطبقي للمنطقة باستخدام البرنامج الحاسوبي "سيرفر-8".

يمكن تطبيق هذه الطريقة منذ البداية لاعطاء توقعات للضغط في المنطقة المحددة إذا لم تتوفر معلومات أو إمكانيات لتطبيق طرق أخرى. وهذه الطريقة الجديدة ستقلل من التكلفة والزمن وتعتبر إضافة حقيقية للصناعة النفطية في السودان.

هذه الدراسة خلصت الى إمكانية إستخدام تسجيلات المقاومة والصوت في حساب الضغط الطبقي لهذه المنطقة بخطأ متوسط مطلق نسبي مقداره 1.13% و 1.16% على التوالي. و وجد بأن خرائط توزيع الضغط الطبقي المحسوب باستخدام معادلتي تسجيلات المقاومة والصوت يشابه توزيع الضغط الحقيقي للمنطقه مسبقا .

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NOMENCLATURE

ASCII	American Standard Code for Information Interchange
CALI	Caliper
DT	Delta-t or Interval transiant time
GR	Gamma Ray
IRS	Indian Remote Sensing Satellite
LAS	Log ASCII Standard
LLD	Laterolog deep resistivity
MAPE	Mean Absolute Percentage Error
mKb	Meters below Kelly Bushing
NPHI	Thermal Neutron Porosity
OOIP	Original Oil In Place
OWC	Oil Water Contact
PEF	Photoelectric Factor
PIGN	Granular porosity
RFT	Repeat Formation Tester
RHOB	Bulk Density
Rt	Total Rsistivity of rock filled with water and oil
Rw	Water Resistivity
Rwa	Apparent water resistivity
SUWI	Water Saturation
SXWI	Invaded zone water saturation
Vcl	Clay Volume