Методические основы создания трехмерного куба поровых давлений по совокупности сейсмических и скважинных данных

Methodological basis for creation of 3D pore pressures cube on set of seismic and well data

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Best practice: 3D Pressure Workflow

- **Pressure View**
  - Review of all pressure data

- **Normal Compaction Generator**
  - Optimised normal compaction trend

- **Overburden Generator**
  - Optimised overburden trend

- **Fracture Gradient Generator**
  - Optimised fracture gradient trend

- **Pore Pressure Analyser**
  - Optimum algorithm

- **3D Pore Pressure Prediction**
  - 3D best estimate

- **3D PPP Uncertainty Analysis**
  - Mean, STD, P10, P90
  - Etc…

RokDoc 1D

RokDoc 3D
RokDoc GeoPressure Package

Target Issue
Module
RokDoc 1D
RokDoc 3D
GeoPressure
Application

✓ PressureView
✓ GeoPressure Calculators
✓ Fracture Pressure Calculator
✓ Framework
✓ Seismic Pressure Calculator

Base Bundle

РокДок GeoPressure Пакет
Exploration and production in high pressure and temperature environments is no longer the exception!

**RokDoc PressureView**
- **Storage, retrieval, display and analysis** of pressure data
- Define **fluid gradients, oil water contacts (OWC)** and **gas oil contacts (GOC)**
- Identify pressure transition zones and compartments
- Unique flexibility with geologically meaningful algorithms

**Now, you can...**
View pressure data alongside lithological columns, pre and post stack seismic, synthetics, attributes and wire line logs in **ONE package**!
An Integrated Interpretation for viewing and testing different contact and boundary scenarios— View Petrophysical data alongside Pressure data (RFT, DST, MDT, etc.)
RokDoc 1D PressureView

How to get accurate pressure analysis?

- Attentive calibration and geologically valid lithostatic pressure profiles, normal compaction trends and Vshale logs

RokDoc Pressure Suite 1D
-- streamlines the process of creating, displaying and analysing lithostatic pressure profiles and normal compaction trends

Resulting pore pressure logs can be displayed in RokDoc PressureView
RokDoc GeoPressure - 1D Module

- **Overburden Calculator**
  - Generate regional overburden trends using offsets well data

- **Normal Compaction Trend Calculator**
  - Allow users to construct normal compact trends from multitude of methods using variable input (Vp, Rho, Resis, etc..)

- **Fracture Pressure Calculator**
  - Perform fracture pressure predictions and QC the results
  - Generate stress ratio and Poisson’s ratio trends

- **Pore Pressure Analyser** *(formerly known as Pore Pressure Calculator)*
  - Essential desktop tool to guide you to the right pressure-velocity model
  - Determine the most suitable model for the area of interest
A Complete 3D Pore Pressure Prediction Workflow

- **Stochastic Calculations**
  - Generate multiple independent pore pressure realisations
  - Recorded or estimated uncertainty input values

- **Probability Analysis**
  - Visualisation of how uncertainty inputs effects the accuracy of prediction
  - Pore pressure realisations output

- **Seismic velocity QC & calibration**

- **3D model & depth-time conversions**

- **Deterministic & stochastic seismic**

**3D pressure predictions can be visualised & exported to SEG-Y volumes**
Calibrate Seismic Velocities

RokDoc and RokDoc 3D Geostatistics functions:

- Kriging the Seismic Vint - Well Vp
  - Difference logs and subtracting the resulting difference cube from the original Vint data

- Kriging the Seismic Vint to Well Vp
  - Fractional difference logs and multiplying the resulting fractional difference cube by the original Vint data

Use **RokDoc Cross-plot** to plot the Vint Volume Data vs Vp Log Data to generate **geologically meaningful mathematical relationship** by fitting trend lines to the plot.
3D Depth-Time Conversions

Options for creating depth-time conversion:

➢ Depth and time horizon pairs
  ▪ Combine time horizon and well data in RokDoc to generate depth

➢ Calibrate interval velocity volume
  ▪ VRMS volumes can be converted to Vint

➢ Quadratic equation
  ▪ Generated by fitting trend lines in RokDoc Cross-plot
Best Estimate ‘deterministic’ pore pressure prediction using:

- Constant pressure gradient
- Constant overpressure
- Pore pressure model (Eaton, Bowers, etc..)
- … 16 different models to choose from!

Pore pressure prediction outcome can be calibrated to measured pressure data at well locations.
Deterministic PPP Example

Seismic Velocities

Vp NCT

Predicted Pore Pressures
Stochastic calculations create a **number of independent pore pressure realisations** by randomly varying the inputs based on user defined uncertainty values.

Overburden pressure and normal compaction trends generated within RokDoc have **associated error bars** that can be used to **determine the uncertainty in the values.**

- The cross correlation between the various inputs can be specified.
RokDoc 3D Pressure Statistical Analysis

Calculating options:
- Mean
- Standard deviation,
- Value at certain probability levels (P10, P90, etc.)

This can be used to calculate upper and lower bound estimates of the pore pressures.

Performed on the realisation sets
- Generate from a stochastic pore pressure prediction

Multi-realisation

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Calibrating Seismic-based PPP

Using RokDoc-PressureView, proposed well location and pseudo-well extracted at trace location 90.

Calibrating pore pressure prediction using Eaton in RokDoc®

3D pore pressure cube

Lithostatic

Hydrostatic

Eaton

Predicted pore pressure (psia)
Export Pore Pressures

Pore Pressure Predictions output:
✓ Inline
✓ Cross line
✓ Arbitrary line
✓ Export to SEG-Y volume files
✓ Export to Petrel
✓ Extract to well path

The uncertainties inputs to the stochastic calculation can be adjusted and the P10 and P90 quantities, extracted logs and PressureView plot will update automatically!

P10 and P90 pore pressure predictions, together with pressure values that were measured when the well was later drilled

Mean, P10 and P90 pore pressure predictions are extracted at the prospect well location.

*The logs is viewed in RokDoc PressureView*
Any Questions?

Thank you

Baltic PetroModel 2012

St. Petersburg, September 2012

Вопросы?
Благодарим Вас за внимание

Any Questions?
Thank you

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