Hydrocarbon Reservoir Permeability Prediction

applying theoretical methods, SCAL and log data, cluster analysis, multi-regression and soft computing approaches

1. Course Facilitator

Professor/ Formation Evaluation and Reservoir Characterisation

Department of Petroleum Engineering, Curtin University

2. Capitalize on expert knowledge to gain maximum value on these vital issues

Understand the underlying principle of reservoir rock permeability

- Gain comprehensive knowledge on permeability prediction methods

- Establish essential prerequisite for integrated reservoir studies

- Apply cluster analysis and multi-regression methods for permeability prediction

- Estimate permeability using intelligent systems such as artificial neural networks (ANN)

- Become familiar with several software for image analysis, cluster analysis and soft - computing purposes.

3. Course Overview

Permeability, the single-phase fluid conductivity of a porous material is a key parameter in determining the value of a hydrocarbon accumulation. It is a complex interplay of porosity and pore geometry. The permeability of rocks varies significantly from several nano-darcies for shales to several darcies for extremely good reservoir rocks. Our ability to predict the magnitude and range of permeability in undrilled areas is rather poor. Thus, it is important to establish suitable methods to obtain an idea of the permeability distribution within a reservoir using a combination of the geophysical, geological, petrophysical and conceptual models. However, to have a realistic model, the magnitude of permeability must be available at least at the well locations.

Prediction of permeability in un-cored sections or wells is a prerequisite for any integrated reservoir studies. Due to its elusive nature and important role in reservoir studies, several methods have been proposed for the purpose of permeability prediction. Selection of proper model will of course not only affect the success of the task of permeability estimation, but also determines the usefulness of estimated permeability. This course will describe several methods for permeability estimation in detail along with some practical applications of the methods.

4. Program Agenda

Introduction to reservoir rock permeability

Basic concepts of permeability

Permeability classification

Permeability controlling parameters

Methods for permeability prediction

A general review on the different methods for permeability prediction

      A review on the empirical equations for permeability prediction

Porosity and facies/electrofacies approach applying cluster analysis for permeability estimation

      Permeability –porosity relationships

      Application of rock fabric/facies/electrofacies concepts and cluster analysis in permeability estimation

Flow Zone Indicator (FZI) and Hydraulic Flow Unit (HFU) approach

      Definition of FZI and HFU

      Permeability estimation using FZI and K-Means clustering

Image analysis application to acquire formation permeability

      Concept of 2D and 3D image analysis

      How to work with image analysis software

      Acquisition and Applications of 3D image analysis

Permeability from Nuclear magnetic resonance (NMR)

      Introduction to Nuclear magnetic resonance (NMR)

      Permeability calculation form NMR log

Application of Mercury Injection Capillary pressure data for permeability estimation

      Introduction to capillary pressure and mercury injection

      Interpretation and applications of mercury injection curves

      Permeability calculation from mercury injection-capillary pressure curve

Artificial neural networks (ANN)

      Introduction to soft computing

      Basics of ANN and how it works

Application of log data and ANN to predict permeability

      Selection criteria for network inputs

      Network design

      Permeability from ANN using MATLAB

Multi-regression analysis to estimate permeability

      Introduction to Multi-regression analysis

      Permeability from Multi-regression analysis using multi-regression software

      Comparison between Multi-regression analysis and ANN results

Practical work on a set of real data using an ANN software

    A set of log data and core permeability will be used to apply ANN, Multi-regression and cluster analysis methods to predict permeability.

5. About Your Course Facilitator

Prof R .R of Department of Petroleum Engineering of Curtin University of Technology, Australia has a PhD in Reservoir Characterization. He has over 20 year's experience in botch academia and industry. During his career, he has been engaged in several research projects supported by national and international oil companies and these commissions, along with his supervisory work at various universities. These have successfully led him to attain a wide range of achievements. He has also supervised over 50 M.Sc. and PhD students during his university career to date. In addition to that, he has published more than 100 peer-reviewed journal and conference papers and is the author of 3 books on petroleum geology, logging and log interpretation.

His research has been focused on integrated solutions for reservoir characterization, formation evaluation and petrophysics. He has utilized expert systems such as artificial neural networks and fuzzy logic and has introduced several new approaches to estimate rock properties from log data where conventional methods fail to succeed. Currently, he is focused on unconventional gas including gas shale and tight gas sand studies, and is the lead scientist for the WA:ERA (EIS) Tight Gas research project.

6. Why You Should Attend?

Permeability is one of the most important and critical petrophysical properties to determine the economic value of a reservoir. Prediction of permeability serves as a platform and prerequisite for any integrated reservoir studies. This workshop is tailor made specifically to bring the highlights of recent technologies and developments on integrated solution for reservoir permeability prediction. Establish solid understanding of permeability prediction using a combination of the geophysical, geological, petrophysical and conceptual models to achieve maximum value of your reservoir.

7. Who Should Attend?

This workshop is specially designed for professionals involved in reservoir characterization. It is highly applicable for individuals from all subsurface disciplines. These include:

- Geophysics,
- Petrophysics,
- Geology,
- Geomodeling,
- Reservoir, and petroleum engineering