Iran section

## SPE-Iran Section Technical Workshop

# Hydrocarbon Reservoir Permeability Prediction

## 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.

## 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.