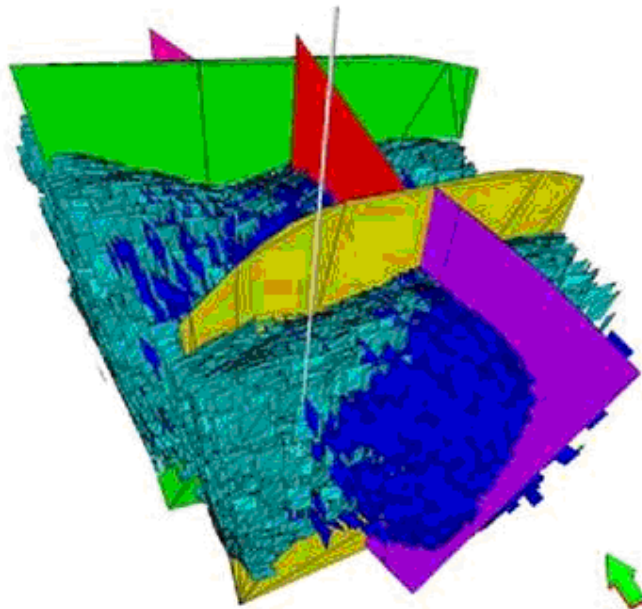


FRACTURED RESERVOIR CHARACTERISATION

27th - 29th February 2012, Kuala Lumpur, Malaysia **2nd run in Asia!**



Dr. Timothy Wynn

Practising Senior Reservoir Geologist with AGR Petroleum Services. Specialist in Geological Reservoir Characterisation and Modelling for over 15 years. Covered locations in the North Sea, Middle East, Europe, Russia, South America, Africa and SE Asia.

Feedback from 2011 in Kuala Lumpur

- Excellent, Clear (Petronas)
- Great place to start thought process around fractured reservoir. (HESS)
- I enjoyed it very much (Mitsubishi Corporation Exploration)
- Knowledgeable lecturer with good material and practical examples. (ROC Oil (Bohai) Company)
- Overall excellent experience. (CSIRO)
- Facilitator's wide experience giving sufficient coverage! (Petronas Carigali Sdn Bhd)
- Effective course in fractured reservoir for reservoir geologist. (Petronas Carigali)

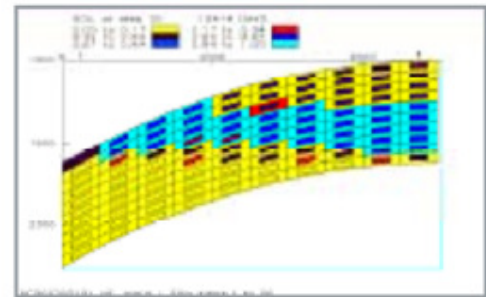
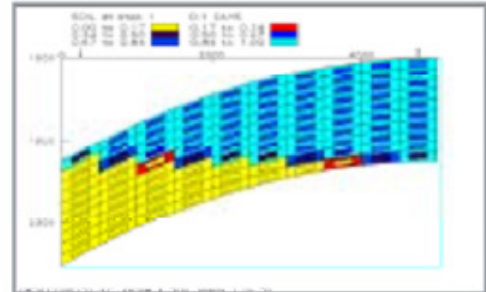
FRACTURED RESERVOIR CHARACTERISATION

27th – 29th February 2012, Kuala Lumpur, Malaysia

Course Introduction

This course provides a practical, integrated approach to characterising and modelling natural fractures where they are important for hydrocarbon delivery.

Fractured reservoirs often display highly heterogeneous dynamic behaviour that is difficult to capture using standard reservoir modelling workflows. This course addresses all the relevant aspects of characterising and modelling fractured reservoirs to allow robust definitions of likely behaviour during production. Early analysis and integration of all available data, including dynamic data, is vital for the geologist and reservoir engineer to define the relationships between fracture and matrix parameters. Likely fracture distribution concepts (fold related, layer bound joints or fault related) can be defined and simple dynamic models built to test against well test or production data. In addition, first pass estimates of fracture porosity, fracture permeability and fracture sigma (fracture-matrix exchange factor) can be calibrated against available data. Fluid type is also important as gas reservoirs often only need simple modelling approaches compared with multiphase reservoirs. If the concepts and initial parameter estimates prove robust, more sophisticated techniques can be employed to produce more accurate models with greater control on parameter sensitivities. Parameters in these models can be defined from heterogeneous properties in geomodelling software or upscaled from Discrete Fracture

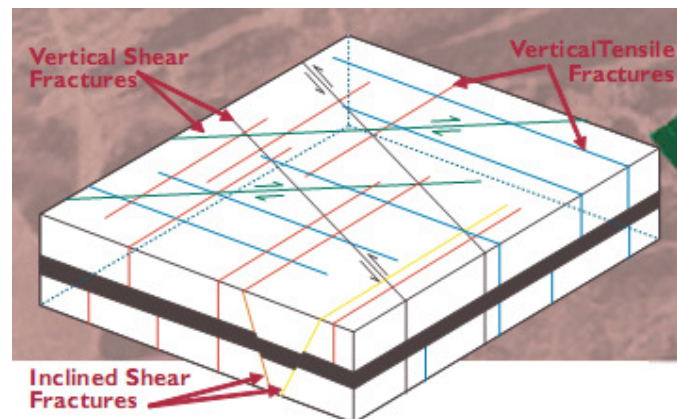


Network packages. Sector models can then be taken and run in reservoir simulators in dual porosity or dual permeability modes. Further upscaling may be required to define useable full field dual porosity or dual permeability models. Throughout this process, iteration of the modelling workflow is key to provide tight integration of all the available data and constrain parameter estimates.

The course goes through the entire process of project definition, data gathering and analysis, concept definition and static and dynamic modelling iterations. This will help participants understand fractured reservoirs and define the most efficient way to model them for a given set of objectives.

On completion of the 3 day training course, course participants will be able to:

- Define what is a fracture reservoir
- Appreciate the economic importance of fractured reservoirs
- Identify and quantify the characterisation of fractured reservoirs
- Understand reservoir modelling of fractured reservoirs
- Discover the typical behaviour of fractured reservoirs
- Improve the management of fractured reservoirs



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FRACTURED RESERVOIR CHARACTERISATION

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3 Day Course Outline

Introduction

Origins and Characteristics of Fractured Reservoirs

- Fracture classification and fracture fill types
- Modes of formation of natural fractures
- Introduction to the stress tensor & Tectonic stresses
- Stresses and rock failure
- Failure envelopes
- Natural fracture system controls
- Regional Fractures
- Joint spacing vs layer thickness
- Tectonic Folds
- Fold related fractures
- Fault related fracturing
- Fault damage zones
- Miscellaneous natural fracture origins

Sampling and Analysis of Natural Fractures

- Wellbore sampling
- Fracture detection (fracture density)
- Fracture Aperture
- Fracture distribution
- Fracture orientation
- Fracture sets, types & fill
- Fracture Permeability

Geomechanics of Fractured Reservoirs

- Maximum horizontal stress (S_{hmax}) orientation
- Vertical stress (S_v)
- Minimum horizontal stress (S_{hmin}) magnitudes
- Maximum horizontal stress (S_{hmax}) magnitudes
- Rock properties
- Failure criteria
- Failure envelopes
- Influence of in-situ stress on fracture permeability

Reservoir Modelling of Fractured Reservoirs

- Geocellular reservoir models
- Calculating fracture permeability in a property grid
- Analytical effective fracture permeability tensor
- Fracture matrix interaction
- Percolation theory
- Fracture system connectivity
- Representative elementary volume
- Discrete Fracture Network models

Reservoir Engineering and Dynamic Simulation

- Basic Principles
- Rock Properties
- Well Productivity
- Well testing
- Recovery mechanisms
- Modelling of fractured reservoirs

Course Schedule in Brief. All sessions start at 9:00am and complete by 5:00pm. Lunch will be served at 12:30pm. Coffee breaks are 10L30 and 3:30pm

Day 1

- Introduction
- Origins and Distribution of - Fractures
- Fracture Characterisation

Day 2

- Fracture Characterisation (continued)
- Geocellular Fracture Modelling
- Reservoir Geomechanics

Day 3

- Discrete Fracture Networks
- Upscaling
- Fractured Reservoir Engineering and Simulation
- Q&A on participants fractured reservoirs

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Who Should Attend

This 3 –day course is designed for practising mid to senior level geologists and reservoir engineers. Geophysicists and petrophysicists aware of reservoir modelling techniques would also benefit.

Your Expert Trainer: Dr. Timothy Wynn



Tim is a specialist in geological reservoir characterisation and modelling. His expertise extends to include reserves audits, project management, geological reservoir modelling for appraisal, concept select and development, volumetrics, well planning, operational monitoring, asset evaluation, and wellbore geomechanics on clastic and carbonate reservoirs. Locations include the North Sea, Middle East, Europe, Russia, South America, Africa and SE Asia. Particular experience in structural geology and fractured reservoir characterisation, modelling and training.

2001 - 2008 – present – AGR Petroleum Services, Aberdeen, Senior Reservoir Geologist
2000 - 2001 - ICE Energy Ltd, Geoscientist
1994 - 2000 - GeoScience Limited, Structural Geologist
1989 - 1990 - British Gas London Research Station, Geological Technician

Experience of using Petrel including extensive evaluation and testing of the Fracture Modelling module. Key projects listed below.

- ❖ Concept select and producing asset reservoir modelling, Premier North Sea.
- ❖ Project Manager, fractured carbonate reservoir studies, Middle East and North Africa.
- ❖ Management of wellbore stability studies, HP sandstone, North Sea and quartzite North Africa.
- ❖ Part of a team auditing reserves in Africa, Russia and Middle East.
- ❖ Fractured reservoir training course preparation and delivery
- ❖ Peer review of North Sea chalk reservoir field development.

Fractured reservoir projects worked on include:

- ❖ Co-wrote and delivered fractured reservoir training courses (EAGE, ONGC, JOGMEC).
- ❖ Fractured sandstone reservoir, reservoir modelling and volumetrics, Clair Field, BP.
- ❖ Fractured carbonate reservoir models for production forecasts, Shell, Italy.
- ❖ Faulted sandstone reservoir modelling, PDO, Oman and Shell, Brunei.
- ❖ Fractured sandstone reservoir modelling for asset evaluation, BHPB, North Africa.
- ❖ Sandstone reservoir (stratigraphic trap) top seal integrity analysis, North Sea.
- ❖ Chalk reservoir acid fracture design and job supervision, BP, North Sea.
- ❖ Fractured carbonate reservoir characterisation, Oil Search, Yemen.
- ❖ Fractured sandstone reservoir characterisation, ATP, Southern North Sea.

Publications

- ❖ 2008 Wynn T.J. Simplified In-Situ Stress Properties in Fractured Reservoir Models. DEVEX Conference 12-13th May 2008, Aberdeen.
- ❖ 2006 Wynn T.J. and Tiefenthal S. Fractured Reservoir Characterisation and Modelling - A Pragmatic Approach. SPE Paper 102453.
- ❖ 2003 Wynn T.J. and Stewart S.A. The role of spectral curvature mapping in characterizing subsurface strain distributions. From: AMEEN, M. (ed.). Fracture and In-Situ Characterization of Hydrocarbon Reservoirs. Geological Society, London, Special Publications, 209, 127–143.
- ❖ 2000 Stewart, S.A. and Wynn, T.J., Mapping spatial variation in rock properties in relationship to scale-dependent structure using spectral curvature. Geology, v. 28, p. 691-694



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REGISTRATION FORM

Kuala Lumpur, Malaysia 27 - 29 February 2012	Early Bird Price	✓	Normal Price	✓	TEAM DISCOUNTS
3 day – Fractured Reservoir Characterisation	S\$ 4359		S\$ 4559		PetroEdge recognises the value of leaning in teams. Group bookings at the same time from the same company receive the following: 3 or more at 5% off 5 or more at 7% off 8 or more at 10%
PetroEdge In-house Training { } Yes, I would like to organise this training on-site and save over 20% of total course fees! For further information about in-house training, please call +65 67419927 or email info@asiaedge.net					All other promotions including early bird is exclusive of the group discount.

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Job Title: -----

Department: -----

Email: -----

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- if you have not received an acknowledgement before the training course, please call us to confirm your booking.
- photocopy this form to register multiple delegates.

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