Fractured Reservoir Modeling
with application to Fractured Basement

Optimize your exploration programs and reservoir modeling process of fractured reservoirs
20th APRIL 2015 - 24th APRIL 2015 at BANDUNG, INDONESIA

PetroSync Distinguished Instructor:
DR. AHMED OUENES
Founder & CEO, FracGeo

- Over 25 years of experience in interpreting and modeling complex reservoirs
- Specialized in advanced reservoir characterization and simulation of fractured reservoirs
- Developed various modern reservoir modeling technologies used in the industry
  - Inventor of CFM Technology (the only fracture modeling technology proven with drill bit)
  - Developed many commercial software (including CRYSTAL, ReFrac, ResFrac, RC Squared etc)
- Completed over 100 integrated reservoir studies throughout the world especially for fractured and tight reservoirs
- Society of Petroleum Engineers (SPE) & American Association of Petroleum Geologists (AAPG), Member

Course Objectives
- UNDERSTAND all geological and seismic aspects related to modeling fractured reservoirs
- ANALYZE the characteristics of basement fractured reservoirs
- GENERATE actual reservoir models from a real case study data set
- INTEGRATE geology, geophysics, geomechanics, and reservoir engineering concepts in application to a sound reservoir model for complex fractured reservoirs and basement
- OVERCOME the challenges in modeling fractured reservoirs through the use of post-stack narrow azimuth seismic
- IDENTIFY fractures and model their density and orientation
- RECOGNIZE productive zones, plan wells, and create fracture porosity and permeability models for reservoir simulation

Specially Designed for
The course is designed for those who deal with fractured reservoirs and those who need to develop them using all types of available data. The course will be very useful to all geoscientists involved in basements, clastics, carbonates, and shale plays where fractures play a major role

- Geophysicists
- Geologists & Geoscientists
- Reservoir Engineers
- Geomodellers
This course provides a unique opportunity to learn all the aspects related to the understanding and modeling of fractured reservoirs. Participants will gain knowledge of how fractured reservoirs differ from conventional reservoirs, and how to approach their fractured reservoir projects in a systematic manner. The workshop covers all the aspects of modeling fractured reservoirs. Emphasis will be given to basement reservoirs and their characteristic.

Using actual data from Teapot Dome, (WY, USA), the geoscientist will be able to construct fracture models that integrate geology, geophysics and reservoir engineering. Emphasis will be given to the critical use of seismic attributes derived from inversion, volumetric curvature and spectral imaging. Using actual Teapot Dome field data from the Tensleep and Niobrara Shale formations, which features complex fractured formations, the workshop allows the geoscientist to identify fractures and to construct predictive 3D fracture models that can be used to identify productive zones, plan wells and to create fracture porosity and permeability models for reservoir simulation.

A multidisciplinary approach to the study of these reservoirs will be stressed. Participants will learn what controls the performance of fractured reservoirs and the type of data which are required to manage them.

This is the only course in the world where attendees use a real software to build fracture models that are validated with blind wells. No other fracturing modeling technology can do that and no other course offer this hands-on approach with these data sets, where the students will leave the class with confidence that they can do it because they have already done it in this course on actual data.

For the provision of the modeling software, participants are requested to bring their LAPTOP with Windows OS.

The REFRACT Software will be provided for the attendees during the course. Unlike the DFN approach, REFRACT uses Continuous Fracture Modeling (CFM) which has been consistently able to reproduce 80% of well performances for any recovery mechanism, and has been proven with the drill bit on numerous fields around the world.

"The instructor is very knowledgeable, and he brings a lot of case studies from around the world. Course materials was extensive. It was almost perfect! This course is very good. “
- Sr. Geologist, Hess Indonesia(2013)

“What I like best about the course is that the instructor explains the concepts easily!”
- Geologists, PVEP (2013)

“The instructor was excellent and has great experience. We learned a lot from him.”
- Development Geologist, SEPOCYE (2013)
Course Outline

I. Fractures and Their Effects
Introduction: Fracture Types
Fractures in Cores
Fractures in Outcrops
Geomechanics and Fractures
Production from Fractured Reservoirs
Fractures in Basement Reservoirs

II. Modeling Fractured Reservoirs
Introduction to Fractured Reservoir Modeling
Factors Affecting Fracturing
Methodologies to Characterize Fractured Reservoirs
The Use of Seismic to Improve the Fracture Modeling
Modeling Basement Reservoirs

III. Seismic Attributes for Fracture Modeling
Post-stack Attributes
Pre-stack Seismic Attributes
Azimuthal Anisotropy
Seismic Attributes in Fractured Basement

IV. Integrated Workflow for Modeling Fractured Reservoirs
Integrated Workflow Applied to Fractured Reservoirs
Hands-on Application : 2 Different Dataset from the Teapot Dome (WY)
Fractured Basement Case Studies

V. Development and Production Preparation
Predicting Production and Development Problems by Reservoir Types
- Development of shale and tight sands
Predicting and Imaging Production Sweet Spots
- Sweet spots identification in unconventional reservoirs
Geomechanical modeling of Hydraulic Fractures interacting with natural fractures
Predicting microseismicity with the geomechanical modeling of hydraulic fractures interacting with natural fractures
Determining Optimum Well Paths
Preparation for Simulation
- Estimation of the Stimulated Reservoir Volume (SRV)
- Reservoir simulation of stimulated unconventional wells
Critical Consideration in Designing Depletion Scenarios in Fractured Reservoirs

After the course, participants will be able to determine the major data requirements and modeling issues associated with various types of fractured reservoirs in general and fractured basement in particular as well as how to set up rational exploration and development programs for these reservoirs. The course will also emphasize the importance of natural fractures and their role in successful stimulation of unconventional reservoirs.

Program Schedule

<table>
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<tr>
<th>Time</th>
<th>Activity</th>
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<tr>
<td>08:00 - 09:00</td>
<td>Registration (Day1)</td>
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<tr>
<td>09:00 – 11:00</td>
<td>Session I</td>
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<tr>
<td>11:00 – 11:15</td>
<td>Refreshment</td>
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<tr>
<td>11:15 – 12:00</td>
<td>Networking Session I</td>
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<tr>
<td>12:00 – 13:00</td>
<td>Lunch</td>
</tr>
<tr>
<td>13:00 – 14:00</td>
<td>Session II</td>
</tr>
<tr>
<td>14:00 – 15:30</td>
<td>Session III</td>
</tr>
<tr>
<td>15:30 – 15:45</td>
<td>Refreshment</td>
</tr>
<tr>
<td>15:45 – 17:00</td>
<td>Networking Session II</td>
</tr>
<tr>
<td>17:00</td>
<td>End of Day</td>
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</tbody>
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Ahmed is the founder and CEO of FracGeo, a technology company that specializes in improving the development of unconventional reservoirs. He has occupied different positions in consulting, academia, R&D, software development, and operating oil and gas fields. Ahmed’s main interest is the development of improved reservoir characterization technologies. He has been focusing lately on new ways to integrate geomechanics with geology and geophysics to predict microseismic events as well as permeability and proppant distribution in the SRV regions for unconventional reservoirs. In the past, Ahmed was a Global Director at SIGMA CUBED and also the founder and president of Prism Seismic, a software and consulting company sold in 2011 to the Symphony Technology Group that formed the SIGMA CUBED group. Previously he was Chief Reservoir Engineer at (RC)2 where he developed the first commercial software for the Continuous Fracture Modeling (CFM) technology. Ahmed was also Executive Vice President of an independent oil and gas producer. Ahmed has successfully characterized and simulated more than 100 fractured reservoirs around the world.

Ahmed graduated from Ecole Centrale de Paris and holds a Ph.D. in Petroleum Engineering from New Mexico Tech. He is the author of more than 70 papers on various complex reservoir studies and new reservoir modeling techniques that covers a wide range of specialties including wettability, geostatistics, upscaling, reservoir simulation and history matching, artificial intelligence, advanced geophysics, fracture modeling, geomechanics and software development. He teaches fracture modeling courses for AAPG, CSEG and other professional organizations.

**Few Completed Projects:**
Completed more than 100 projects that integrate geophysics, geology, and reservoir simulation into coherent reservoir models that are validated with actual drilling. Among his recent projects are:
- 2014 Multiple US Shale Operators (USA) Predicting well performances in Bakken, Eagle Ford, Marcellus, Haynesville, Mississippi Lime, Barnett, and Niobrara
- 2013 ZADCO (Abu Dhabi, UAE), Characterization of Thamama thin beds
- 2012 Daleel Petroleum (Oman) Characterisation and simulation of a carbonate reservoir
- 2012 Cooper Energy (Perth Australia) – Abiod Fracture Modelling in Tunisia
- 2011 Spectra Energy (Texas USA) – Fractured Gas Storage Characterization
- 2011 Anadarko (Texas USA) – Marcellus Shale Characterization
- 2010-2011 AGOCO (Libya) – Integrated Studies in Ghadames and Sirte Basins

**Publications:**
- Predicting Microseismicity from Geomechanical Modeling of Multiple Hydraulic Fractures Interacting with Natural Fractures – Application to the Marcellus and Eagle Ford, URTeC 1923762, 2014
- Estimation of Stimulated Reservoir Volume using the concept of Shale Capacity and its validation with microseismic and well performance: application to the Marcellus and Haynesville, SPE 169564, 2014
- Distribution of well performances in shale reservoirs and their predictions using the concept of shale capacity, SPE 167778, 2014.
- Seismically driven characterization of unconventional shale plays, CSEG Recorder, Feb 2012
- Integrated Characterization and Simulation of the Fractured Tensleep Reservoir at Teapot Dome for CO2 Injection Design SPE 132404, 2010
- Impact of Pre-Stack and Post-Stack Seismic on Integrated Naturally Fractured Reservoir Characterization (SPE 87007, 2004)
- Integrated Fractured Reservoir Characterization and Simulation: Application to Sidi El Kilani Field, Tunisia (JPT)
COURSE DETAILS
Title : FRACTURED RESERVOIR MODELING with application to Fractured Basements
Date : 20th - 24th April 2015
Location : BANDUNG, INDONESIA

INVESTMENT PACKAGES

<table>
<thead>
<tr>
<th>Investment Package</th>
<th>Deadline</th>
<th>Full Masterclass</th>
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<tbody>
<tr>
<td>Standard Price</td>
<td>17th APR 2015</td>
<td>SGD $ 5,995</td>
</tr>
<tr>
<td>Early Bird Offer</td>
<td>20th MAR 2015</td>
<td>SGD $ 5,795</td>
</tr>
<tr>
<td>Group Discount (3 or more Delegates)</td>
<td>17th APR 2015</td>
<td>10% discount for groups of 3 registering from the same organization at the same time</td>
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* To enjoy the promotion & discount offer, payment must be made before deadline
* Prices include lunches, refreshments and materials. Promotion & discount cannot be combined with other promotional offers.
* Important: Please note that registration without payment will incur a SGD 200 administration fee.

DELEGATES DETAILS

1st Delegate Name ____________________________ Mr □ Mrs □ Ms □ Dr □ Others □
Direct Line Number: __________________________ Email: __________________________
Job Title: __________________________ Department: __________________________
Head of Department: __________________________

2nd Delegate Name ____________________________ Mr □ Mrs □ Ms □ Dr □ Others □
Direct Line Number: __________________________ Email: __________________________
Job Title: __________________________ Department: __________________________
Head of Department: __________________________

3rd Delegate Name ____________________________ Mr □ Mrs □ Ms □ Dr □ Others □
Direct Line Number: __________________________ Email: __________________________
Job Title: __________________________ Department: __________________________
Head of Department: __________________________

INVOICE DETAILS

Attention Invoice to: __________________________
Direct Line Number: __________________________ Fax: __________________________
Company: __________________________ Industry : __________________________
Address: __________________________ Postcode: __________________________
Country: __________________________ Email: __________________________

- Please note:
  - Indicate if you have already registered by Phone □ Fax □ Email □ Web □
  - If you have not received an acknowledgement before the training, please call us to confirm your booking.

PAYMENT METHODS

☐ By Credit Card :
  - Please debit my credit card: □ Visa □ MasterCard □ AMEX
  - Security Code: ____________
  - Card Number: __________________________
  - Name printed on card: __________________________

☐ By Direct Transfer: Please quote invoice number(s) on remittance advice
Petrosync Global Pte Ltd Bank details:
Account Name: Petrosync Global Pte Ltd
Bank Name : DBS Bank Ltd
Bank Code : 7171 • Bank Swift Code : DBSSSGSGXXX • Branch code : 288
Account No. : SGD : 2889018980 • USD : 0288002682016
All bank charges to be borne by payer. Please ensure that Petrosync LLP receives the full invoiced amount.

DATA PROTECTION

The information you provide will be safeguarded by Petrosync that may be used to keep you informed of relevant products and services. As an international group we may transfer your data on a global basis for the purpose indicated above. If you do not wish to share your information with other reputable companies, please tick this box ☐.

TERMS AND CONDITIONS

CANCELLATION POLICY
You may substitute delegates at any time as long as reasonable advance notice is given to Petrosync. For any cancellation received in writing not less than fourteen (14) working days prior to the training course, you will receive credit voucher less a SGD $200 administration fee and any related bank or credit card charges.

In the event that Petrosync cancels or postpones an event for any reason and that the delegate is unable to attend in the rescheduled date, you will receive credit voucher for 100% of the contract fee paid. You may use this credit voucher for another Petrosync course.

PETROSYNC’S CERTIFICATE.
70% ATTENDANCE IS REQUIRED FOR ISSUANCE OF PETROSYNC’S CERTIFICATE.

CERTIFICATE OF ATTENDANCE

Course Confirmation

I agree to Petrosync’s terms & conditions,payment terms and cancellation policy.

Authorized Signature :

PAYMENT TERMS : Payment is due in full at the time of registration. Full payment is mandatory for event attendance.