CARBONATE GEOLOGY
FOR EXPLORATION AND PRODUCTION

Describe and classify typical carbonate rocks, interpret facies relationships, delineate stratigraphic sequences to evaluate reservoir quality and better understand subsurface carbonate plays and reservoirs.

27th JULY 2015 - 31st JULY 2015 at KUALA LUMPUR, MALAYSIA

PetroSync Distinguished Instructor:
DR. JEFFREY DRAVIS
Carbonate Geologist & Consultant
President, Dravis Geological Services

- Premier consultant and experienced course instructor with 35 years experience in the O&G industry
- Specialized in carbonate sedimentology and petrology, discovering the controls on diagenesis and porosity evolution in carbonate sequences that aid in exploiting carbonate reservoirs
- He has worked numerous carbonate projects in Africa, the Middle East, Southeast Asia and South America, as well as working Jurassic and Cretaceous sequences of the Gulf of Mexico, Devonian and Mississippian in western Canada, and Ordovician-Permian in west Texas and New Mexico
- He has presented over 230 in-house and field carbonate seminars for industry clients, including over 65 field seminars on Caicos Platform in the southern Bahamas

Testimonials

"This was one of the best 5-day courses I have taken - learned enough about carbonates that I could start a carbonate project and know where to look for help and what type of preparation I need, and that should help the company."

"It is obvious that Jeff has taught this course many times - excellent command of material and direction for the course. One of the best courses I've attended."

"Instructor was very knowledgeable and thought-provoking. He appeared thoroughly competent in all aspects of carbonate geology, and possessed a very likable personality and temperament. Works very well with people."

Course Objectives

- CLASSIFY AND IDENTIFY characteristics of a typical carbonate rock
- EVALUATE reservoir quality in limestones and dolostones
- INTERPRET facies relationships, delineate stratigraphic sequences and correlate facies within them
- IMPROVE UNDERSTANDING of hydrocarbon play relationships associated with both shallow – and deep-marine sequences
- UNDERSTAND the interrelationship between reservoir, source, seal and trapping mechanism
- LEARN how to zone carbonate reservoir to more effectively extract oil and gas

Specially Designed for

This program is designed for Exploration Geologist, Geophysicist, Reservoir Engineering, Log Analyst, Exploration Supervisors, and Subsurface Managers who are currently working or will be working with carbonate systems exploration, and are in need of a better understanding of the key subsurface properties for exploration and production. Geologists working with mixed carbonate and siliciclastic sequences will also benefit from this program.

Pre-Requisite: Attendees are expected to have a working knowledge on basic petroleum geology.

Supported by
This five-day program introduces participants to established principles of carbonate sedimentology applied to hydrocarbon exploration and development geology.

The purpose of this seminar is to introduce participants to established principles of carbonate sedimentology, applied to hydrocarbon exploration and exploitation. Hydrocarbon play relationships associated with both shallow- and deep-marine sequences are emphasized, stressing the interrelationship between reservoir, source, seal and trapping mechanism. How one zones a carbonate reservoir to more effectively extract oil and gas is discussed as well.

Using a highly acclaimed, hands-on and rock-based approach, each participant learns to describe typical carbonate rocks, delineate facies and sequences, evaluate reservoir quality, relate carbonates to log and seismic expression, better predict play relationships in the subsurface, and construct a time-stratigraphic facies framework essential for both accurate regional correlation of carbonate sequences and zonation of carbonate reservoirs. Lectures are reinforced with exercises and problems keyed to identical sample rock sets, each containing 56 representative samples from around the world. A 750+ page notebook, with color copies of all power point slides shown in lectures, accompanies the course, as well as a reference book with pictures of samples used in various exercises. This seminar has been presented to industry over 100 times!

**Course Outline**

**DAY 1: Distinctive Aspects of Carbonates || Non-Skeletal Grains & Skeletal Grains**

**DISTINCTIVE ASPECTS OF CARBONATES**
- Introduction to unique attributes of carbonate facies and controls on their deposition

**GRAIN TYPES**
- Non-skeletal and skeletal components of limestones
- Criteria for their recognition and environmental significance [EXERCISE]

**CARBONATE CLASSIFICATIONS AND SEDIMENTARY STRUCTURES**
- Review of popular classification schemes; discussion of typical sedimentary textures and structures inherent to carbonates, and their significance for interpreting environmental setting [EXERCISE]

**DAY 2: Carbonate Classifications and Structures || Limestone Diagenesis and Porosity Evolution**

**LIMESTONE DIAGENESIS AND POROSITY EVOLUTION**
- Basic geochemical principles governing diagenetic reactions
- Carbonate mineralogies and their influence on diagenesis
- Diagenetic environments and associated processes and products, including cementation and porosity modification in marine, fresh water and burial diagenetic environments
- Diagenetic fabrics - their recognition and significance; controls on carbonate diagenesis
- Guidelines for predicting porosity trends in the subsurface
- New techniques for more effective evaluation of diagenetic history and reservoir quality [EXERCISE]

**DOLomitization AND POROSITY EVOLUTION**
- Review of geochemical principles governing dolomite formation
- Controls on dolomitization
- Review of standard models of dolomitization
- Porosity development/modification associated with dolomitization
- Review of new techniques to interpret facies and timing of porosity evolution in massive dolomites [EXERCISE]

**CARBONATE POROSITY TYPES**
- Review of Choquette and Pray scheme for classifying carbonate pore types [EXERCISE]
Course Outline

**DAY 3: Dolomitization and Porosity Evolution Porosity Classification; Attributes**

7. CARBONATE FACIES MODELS
- Discussion of controls on facies occurrence and distribution
- Attributes and criteria for recognition of basinal facies, foreslope facies, platform reef systems, oolitic sand complexes, platform-interior grapestones, subtidal pelleted sands and lime muds, and carbonate tidal flats
- Review of predictive end-member models: the ramp and platform with a steeply-dipping margin
- Use of Holocene two-dimensional models stressing comparative sedimentology, environmental relationships, geometries and preservable facies attributes review of classical models of shallow-marine carbonate deposition from the Caribbean, Arabian Gulf and Australia
- Role of trade winds in carbonate deposition

8. VERTICAL DEPOSITIONAL SEQUENCES AND CYCLICITY
- Facies components of ancient carbonate sequences and their upward-shoaling character
- Recognition of depositional sequences and cyclicity in outcrops and cores
- Major controls on depositional cyclicity
- Geometries within depositional cycles
- Geometries between depositional cycles
- Effects of progradation and backstepping on carbonate facies distribution and geometry
- Guidelines for predicting depositional cyclicity in ramps or steep-margined platform settings
- Use of depositional cyclicity for local and regional time-stratigraphic correlation - implications for exploration and development geology

**DAY 4: Carbonate Depositional Sequences & Cyclicity; Log and Seismic Expression of Carbonates; Core Exercise With Logs**

9. LOG AND SEISMIC EXPRESSION OF CARBONATES
- Use of wireline logs in delineating carbonate facies and depositional cyclicity
- Pitfalls in log pattern correlations; seismic expression of carbonate buildups and other facies
- Pitfalls of seismic interpretation; evaluation of existing carbonate sequence stratigraphic models

10. CORE PROBLEM
- A suite of cores allows delegates the opportunity to interpret depositional facies, break out depositional cycles and vertical sequences, tie facies and porosity to cyclicity and log response, and assess regional depositional setting

**PROGRAM SCHEDULE**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>08:00</td>
<td>Registration (Day1)</td>
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<tr>
<td>09:00</td>
<td>Session I</td>
</tr>
<tr>
<td>11:00</td>
<td>Refreshment &amp; Networking Session I</td>
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<tr>
<td>11:15</td>
<td>Lunch</td>
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<tr>
<td>12:00</td>
<td>Session II</td>
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<tr>
<td>13:00</td>
<td>Lunch</td>
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<tr>
<td>14:00</td>
<td>Session III</td>
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<tr>
<td>15:30</td>
<td>Refreshment &amp; Networking Session II</td>
</tr>
<tr>
<td>15:45</td>
<td>Session IV</td>
</tr>
<tr>
<td>17:00</td>
<td>End of Day</td>
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</table>

**HYBRID TRAINING SOLUTIONS**

**FOCUS TRAINING • REDUCE COST • ENHANCED RESULTS**

Over the years, there has been a growing demand for hybrid training programs. It is an excellent option to maximize your training dollar for your specific training needs. We make it possible to run a training program that is customized totally to your training needs at a fraction of an in-house budget!

If you like to know more about this excellent program, please contact us on +65 6415 4500 or email general@petrosync.com
DAY 5: Carbonate Play Types and Review of Case Studies; Use of Depositional Cyclicality to Zone Carbonate Reservoirs; Carbonate Facies Correlation

11. CARBONATE PLAY TYPES
• Discussion of a classification scheme relating physiographic setting to geometry of plays
• Review of reservoir, source, seal and trap relationships for conventional carbonate plays, including platform-margin sands, platform-margin reefs, platform-interior mounds, platform-interior subtidal muds and tidal flats, and downslope mounds
• Review of unconventional carbonate plays, in particular, foreslope deposits and basinal chalks
• Review of case studies are discussed for each play type; extensive bibliography

12. USE OF DEPOSITIONAL CYCLICITY TO ZONE CARBONATE RESERVOIRS
• Demonstrates how established principles of carbonate depositional cyclicality can be applied to more effective zonation of existing carbonate reservoirs
• Reviews tangible benefits which result from using this approach, including development of field extensions, wedge-edge prospects, improved well excellence and more effective recompletions

13. CARBONATE FACIES CORRELATION EXERCISE
• Exercise utilizing rock sample sets to reinforce key points discussed during the seminar. In this exercise, delegates are required to interpret facies and vertical sequences based on samples from four wells, develop a map depicting the regional physiographic setting, construct a time-stratigraphic cross section in which time-equivalent facies packages are correlated, and evaluate the merits of potential play relationships based on their cross section. This popular exercise challenges the delegates to apply all the information they have learned during the seminar [EXERCISE]

NOTE: Discussions on evaporites and carbonate source rocks are integrated into some of the topics noted above. If desired, separate lectures on these two topics can be provided (see below):

EVAPORITES
• Controls on evaporite formation and distribution; review of environments of formation and models
• Depositional and diagenetic fabrics; interrelationships between evaporites and carbonate sequences

CARBONATE SOURCE ROCKS
• Discussion of controls on preservation of organic matter in carbonate facies
• Review of models for predicting carbonate source rock potential
• Carbonate source rock case studies, including discussion of how various techniques and approaches aided a regional evaluation of hydrocarbon migration distances and pathways

Petrosync Quality
Limited Attendees
The course has limited seats to ensure maximum learning and experience for all delegates.

Certificate of Attendance
You will receive a Certificate of Attendance bearing the signatures of the Trainer upon successful completion of the course. This certificate is proof of your continuing professional development.

Interactive Training
You will be attending training designed to share both the latest knowledge and practical experience through interactive sessions. This will provide you with a deeper and more long-term understanding of your current issues.

High Quality Course Materials
Printed course manual will provide you with working materials throughout the course and will be an invaluable source of reference for you and your colleagues afterward.
Jeffrey Dravis is a carbonate geologist with 35 years of experience and owner of Dravis Geological Services, which conducts exploration and reservoir development projects in the U.S., Canada and overseas. He specializes in unravelling the controls on diagenesis and porosity evolution in carbonate sequences that aid in exploiting carbonate reservoirs. He applies innovative petrographic techniques to relate rock-based observations to well logs and seismic data, helping clients better define their subsurface plays and prospects. He has worked numerous carbonate projects in Africa, the Middle East, Southeast Asia and South America, as well as working Jurassic and Cretaceous sequences of the Gulf of Mexico, Devonian and Mississippian in western Canada, and Ordovician-Permian in west Texas and New Mexico. He has consulted for most of the large and smaller independent oil and gas companies in the U.S and Canada.

He is also the president of Dravis Interests, Inc., through which he conducts applied carbonate training seminars for the industry. Since 1987, he has presented well over 200 in-house and field carbonate seminars for industry clients, including over 65 field seminars on Caicos Platform in the southern Bahamas. He received his B.Sc. (geology) from St. Mary’s University in San Antonio, his M.Sc. (Marine Geology) from the University of Miami’s Rosenstiel School of Marine and Atmospheric Sciences, and a Ph.D. (geology) from Rice University, Houston. He worked for Exxon Production Research Company, in Houston, for eight years, before becoming a full-time consultant over 25 years ago. Since 1987, he has been an adjunct professor at Rice, where he teaches part-time and mentors students.
Title: CARBONATE GEOLOGY FOR EXPLORATION & PRODUCTION
Date: 27-31 JULY 2015
Location: KUALA LUMPUR, MALAYSIA

**INVESTMENT PACKAGES**

<table>
<thead>
<tr>
<th>Investment Package</th>
<th>Deadline</th>
<th>5-DAY MASTERCLASS</th>
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</thead>
<tbody>
<tr>
<td>Standard Price</td>
<td>25 JUL 2015</td>
<td>SGD $ 5995</td>
</tr>
<tr>
<td>Early Bird Offer</td>
<td>26 JUN 2015</td>
<td>SGD $ 5795</td>
</tr>
<tr>
<td>Group Discount (3 or more Delegates)</td>
<td>25 JUL 2015</td>
<td>10% discount for groups of 3 registering from the same organization at the same time</td>
</tr>
</tbody>
</table>

- Group Discount is based on Standard Price
- To enjoy the promotion & discount offer, payment must be made before deadline
- For 7 or more delegates, please inquire for more attractive package.
- 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: __________________________
Job Title: __________________________
Head of Department: __________________________

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

3rd Delegate Name: [Mr □ Mrs □ Ms □ Dr □ Others □]
Direct Line Number: __________________________
Job Title: __________________________
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: □ Visa □ MasterCard □ AMEX
- Security Code: __________
- Card Number: __________
- Expiry Date: __________

- 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: DBSSSGSSXXX • Branch code: 288
Account No: • SGD: 2889018980 • USD: 0288002682016

All bank charges to be borne by payer. Please ensure that PetroSync Global Pte Ltd receives the full invoiced amount.

**TERMS AND CONDITIONS**

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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 want us to share your information with other reputable companies, please tick this box □

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.

Delegates who cancel less than fourteen (14) working days of the training course, or who do not attend the course, are liable to pay the full course fee and no refunds will be granted.

In the event that PetroSync cancels or postpones an event for any reason and that the delegate is unable or unwilling to attend on the rescheduled date, you will receive a credit voucher for 100% of the contract fee paid. You may use this credit voucher for another PetroSync course, which must occur within a year from the date of postponement.

PetroSync is not responsible for any loss or damage as a result of the cancellation policy. PetroSync will assume no liability whatsoever in the event this event is cancelled, rescheduled or postponed due to any Act of God, fire, act of government or state, war, civil commotion, insurrection, embargo, industrial action, or any other reason beyond management control.

CERTIFICATE OF ATTENDANCE
70% attendance is required for PetroSync’s Certificate of Attendance.

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All of PetroSync’s offices and training programmes are free of harassment and discriminatory practices.

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**DIsclaimER**

Please accept our apologies for mail or email that is incorrectly addressed. Please email us at registration@petrosync.com and inform us of any incorrect details. We will amend them accordingly.

**PAYMENT METHODS**

- By Credit Card: □ Visa □ MasterCard □ AMEX
- Security Code: __________
- Card Number: __________
- Expiry Date: __________

- 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: DBSSSGSSXXX • Branch code: 288
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Course Confirmation

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

Authorized Signature: __________________________