On – the – Job (OJT) Geosciences Training

In collaboration with

ROBERTSON
A CGG Company

For more information, visit us at

www.petroedgeasia.net
On-the-job training (OJT), is an attachment training that takes place at Robertson offices utilising the expertise and facilities located there. The OJT programmes can be on any subject that can be supported at Robertson offices and can employ a range of analysis techniques available. OJT provides a flexible platform for organisational learning, involving systematic coaching of employees by skilled staff using structured training processes and training documents. Depending on the programme content and duration, trainees may bring their own data and work this up into a fully QC’d project. This proves very cost effective for our clients as their employees are receiving training while the data is being analysed and interpreted. Trainees will work alongside Robertson specialists who employ a variety of teaching techniques. Programmes are intended to be cost effective as OJT usually involves part contact time with instructors and part self-guided practical work. As the training is conducted at Robertson offices, trainees have access to a range of subject specialists, and Robertson laboratories can provide a range of sedimentological and geochemical analysis techniques.

The programmes may be shorter term intensive training of a small group of trainees, or extended programmes of highly focussed, high level training of 1 or 2 participants. The data used may be the clients’ own data or Robertson non-exclusive data.

Up to 80% of work skills are acquired on the job, OJT is vital in the retention of critical skills and knowledge, which will help organisations respond quickly to the changing business requirements. In addition, companies that implemented structured OJT reported up to 50% improvement in time-to-market, wastage reduction, customer service and staff retention, customer service and staff retention.

With OJT, your company can respond faster to customers, improve staff performance and achieve better business results.

In collaboration with ROBERTSON CGG, petroEDGE is able to provide a variety of OJT opportunities, the following are some examples of previous OJT programmes:

- **Thin Section Preparation Training**
  *Duration: 4 Weeks*

- **Sequence and Seismic Stratigraphy**
  *Duration: 4 weeks*

- **Carbonate Sedimentology**
  *Duration: 6 months*

- **Nannofossil, Palynology and Palynofacies**
  *Duration: 4 Weeks*

- **Image Log Interpretation**
  *Duration: 6 weeks*

- **Petrophysics**
  *Duration: 12 weeks*

- **Prospect Generation**
  *Duration: 18 weeks*

- **Reservoir & Geosciences**
  *Duration: 24 weeks*

- **Structural Geology**

- **Mapping Subsurface Structures**

- **Seismic Interpretation**

- **3D Interpretation**
The following are examples of content and duration of attachment training programmes previously held at Robertson. We can tailor attachment programmes to suit your requirements. The following are intended to give an indication of the range of content Robertson can support. Programme duration can be 2 weeks up to 6 months.

### THIN SECTION PREPARATION TRAINING PROGRAMME

**Week 1**
- Laboratory Health and Safety Induction
- Laboratory Tour
- Laboratory procedures for preparation
- Training on Initial Preparation of Samples
- Preparation of mounting mediums and blue dye impregnation
- Basic Principles of Laboratory Work

**Week 2**
- Training on Thin section preparation
- Slide mounting, grinding and polishing.
- Quality Control on prepared slides
- Fault finding
- Working with Hazardous chemicals/solvents (Control of Substances Hazardous to Health)

### SEQUENCE & SEISMIC STRATIGRAPHY

**Duration: 4 Weeks**

**Week 3**
- Preparation of own samples under supervision
- Carbonate staining and preparation of solution
- Quality Control of own samples
- Basic Principles of Laboratory Safety

**Week 4**
- Preparation of own samples under supervision
- Feldspar staining and preparation of solutions
- Quality Control of own samples
- Basic Principles of Laboratory Practices
- Overview of training

### INTEGRATED SEQUENCE STRATIGRAPHY

**Part 1: Duration: 2 Weeks**

#### Sequence Stratigraphy

This course will follow a workshop format. The workshop will emphasise the underlying geological principles, processes and terminology related to the interpretation and use of seismic sequence stratigraphy and its integration with well log sequence stratigraphy and biostratigraphy. It will also provide attendees with the opportunity to interpret the sequence stratigraphy of part of a selected sedimentary basin.

**Key learning objectives:**
- Understand sequence stratigraphic concepts and controls
- Identify systems tracts and stratigraphic sequences from depositional facies, well logs and seismic facies.
- Construct a sequence stratigraphic model by integrating lithological, biostratigraphical, seismic and well data.

**Contents:**
- Introduction - Introduction to seismic sequence stratigraphy; concepts; eustatic controls; assumptions; definition of key terms.
- Eustatic controls on depositional stratal patterns - Accommodation and equilibrium types; systems tract boundaries.
- Seismic expression of sequence - Criteria and approach for picking sequence boundaries.
- Interpretation of seismic reflections in depositional sequences - Definition of seismic sequence; seismic facies.
- Sequence and systems tracts - Highstand; falling stage; lowstand; transgressive; shelf margin systems tracts.

### SEISMIC SEQUENCE STRATIGRAPHY

**Duration: 4 Weeks**

**Part 2: Duration: 2 Weeks**

#### Seismic Sequence Stratigraphy

This part of the course will cover the following topics:
- Introduction: Philosophy and History
- Geophysical Fundamentals
- Breaking Out Operational Sequences
- Introduction to Fault Interpretation
- Chronostratigraphy Construction and Interpretation
- Sea Level Curves, Accommodation Space, and Cycle Orders
- Vail Sequence Theory and Sequence Hierarchy
- Carbonate Sequences
- Siliciclastic Sequences
- Seismic Facies
- Paleo-Environmental Analysis
- Geohistory Reconstruction
- Optimizing Exploration

### CARBONATE SEDIMENTOLOGY

**Duration: 6 months**

- Depositional set up of carbonate rocks emphasising the carbonate setting
- Diagenetic aspects of carbonate rocks
- The complexities of diagenesis
- Carbonate Facies and classifications
- How to relate depositional and diagenetic properties with reference to sequence stratigraphic framework
- How to relate depositional and diagenetic events with respect to reservoir characterization
- Image logs and their utilization to Sedimentology (superficial coverage of the topic)
- Use of XRD, SEM, Cathodoluminescence, Fluid inclusion analyses etc. in Carbonate Sedimentology (superficial coverage of the topic)
- Thin section petrography
- Specialist techniques including Qemscan (superficial coverage of the topic)
- Local field trip(s) to understand the depositional patterns of the rocks

---

*Call +65 6741 9927 to enquire or email your query to info@asiaedge.net. Visit us at www.petroedgeasia.net for more information.*
## NANNOFOSSIL, PALYNOLGY AND PALYNOFACIES

**Week 1 & 2**
- Nannofossil and foraminifera analysis and age dating of samples (dependant on experience level and/or section of interest a further month may be required prior to this stage).

**Week 3**
- Palynology slide and palynofacies analysis (spore colour index).
- Integration of nannofossil and foraminifera data plus integration.
- Further integration and discussion of the well/wells in the wider basinal setting and the implications on basin modelling.

## IMAGE LOG INTERPRETATION

### Week 1 to 2:
**Clastic Reservoir Geology**
- Clastic facies analysis and depositional environments
- Principles of facies analysis; depositional environments and facies sequences, ancient and modern - desert, fluvial, deltaic, estuarine, marine shoreline, shallow marine shelf and deep marine environments; geometry of clastic reservoirs; depositional modelling and mapping. Integration of the models with tectonics and seismic sequence stratigraphy.

**Log Response In Clastic Sequences**
- Core logging; lithology determination from wireline logs; core to wireline log correlation; palaeoenvironmental mapping.
- Interpretation of lithologies from conventional logs
- Quick look interpretation of porosity and hydrocarbons
- Some sedimentological indications from wireline log patterns
- Zoning a section for reservoir engineering purposes
- Interwell correlation using logs and other data, including advanced techniques
- The dipmeter log

**Clastic Petrography And Diagenesis**
- Detrital mineralogy and texture; diagenetic petrography - recognition and quantification, cement types, porosity destruction and enhancement; diagenetic/porosity modelling and mapping.
- Exploration sedimentology in play fairway mapping and basin analysis
- Methods of basin-wide correlation and layering and the production of isochore, N/G, porosity and permeability maps for use in play fairway definition.
- Volumetric assessment in clastic reservoirs

### Week 3
**Formation Microscanner (FMS) Log Interpretation**
- FMS and other borehole micrologs (OBMI, CMR etc)
- e.g. CYBL, Televiewer, DUALDIP, MSD, principles, operating conditions, output, resolution
- FMS interpretation
- Methods of determining orientation of dipping features, correction for borehole drift, reorientation of cores
- Recognition of structures in cores - slab/outside surface
- Recognition of structures from FMS

**Week 4**
- Correlation of the well/wells to wireline logs and seismic (if provided) leading to the construction of a high resolution sequence stratigraphy (where data allows). Depositional setting will be analysed and reported.
- In the final week we would provide instruction in reporting of results and presentational skills with the training course concluding in a PowerPoint presentation (given by the attendee with the support of the mentor) to a selected group of FRL staff on the work undertaken.

### Image 1 to 2:
**Clastic Reservoir Geology**
- Volumetric assessment in clastic reservoirs use in play fairway definition.
- Production of isochore, N:G, porosity and permeability maps for use in play fairway mapping and basin mapping.
- Depositional destruction and enhancement; diagenetic/porosity modelling and mapping.
- sandstone porosity
- Factors controlling diagenesis
- Packing, porosity and permeability
- Diagenetic processes in relation to sandstone porosity
- Porosity enhancement
- Environmental indicators and provenance

### Image 3 to 4:
**Sequence Stratigraphy**
- Introduction
  - Introduction to seismic sequence stratigraphy; concepts; eustatic controls; assumptions; definition of key terms.
- Eustatic controls on depositional stratal patterns
  - Accommodation and equilibrium types; systems tract boundaries.
- Sequence and systems tracts
  - Highstand; falling stage; lowstand; transgressive; shelf margin systems tracts.
- Sequence expression in well logs
  - Log characters of parasequences, maximum flooding surfaces and criteria for picking sequence boundaries.
- Interpretation of systems tracts from well log character
  - Integration of well log sequence stratigraphy with seismic sequence Stratigraphy. Correlation, layering
- Clastic and carbonate depositional environments
  - Depositional responses to changes in relative sea level
- Variation on the model: Application and exploration significance
  - Use of global sea level curve.

**Week 5 - 6**
**Thin Section Petrography and Data Integration**
- An introduction to clastic / carbonate petrography
- Grain textures
- Clastic / carbonate grain types (detrital mineralogy)
- Classification
- Diagenetic mineralogy
- Porosity

**Clastic Petrography will cover**
- Thin section preparation
- Staining techniques
- Thin section petrography basics
- Identification of grains
- Texture (grain size, sorting, shape and fabric)
- Point counting (modal) analysis
- Classification of sandstones
- Packing, porosity and permeability
- Factors controlling diagenesis
- Diagenetic processes in relation to sandstone porosity
- Porosity enhancement
- Environmental indicators and provenance

---

**Duration:** 4 Weeks

**Duration:** 6 Weeks
PETROPHYSICS

The training program will include discussions on the theory and application of conventional and advanced core and log analysis techniques (as outlined below). Theoretical discussions will be augmented by practical examples supplied by FRL together with real examples provided by the trainee.

Core Analysis
This section will review the following:
- Theory of the key rock and fluid properties (porosity, permeability, fluid saturation, capillary pressure, wettability, cation exchange capacity).
- Sampling strategies for selection of conventional and special core analysis samples.
- Core analysis methods for measurement of the above properties, including conventional and special core analysis methods.
- A review of the limitations, uncertainties and quality control of petrophysical analysis methods.

Conventional Open Hole Logs and Logging While Drilling
This section will provide an overview of conventional open hole log theory and application, to provide a foundation for the review and application of more advanced log analysis technology in the next section.

This section will include:
- Conventional log quality control and data preparation (the borehole environment, log data editing)
- Lithology determination theory and methods
- Porosity determination theory and methods
- Saturation determination theory and methods

Advanced Log Analysis
This section will entail review of the theory and application of a range of advanced log analysis methods, including:
- Borehole Image Analysis: This section will include resistivity, sonic and induction-based image analysis systems.
- NMR Analysis: Evaluation of fluids and pore systems.
- Full Waveform Sonic Analysis: Analysis of compressional, shear and stoney waves and their application to formation evaluation.
- Multi-mineral and spectral analysis methods for complex mineralogies.

Formation Evaluation Workflows
This section will review how the variety of petrophysical and log analysis methods can be integrated to determine porosity, permeability and fluid saturations in complex reservoirs, including:
- A comparison of methods available for conductive and non-conductive mud systems
- Low resistivity net pay intervals
- Shaly sand analysis methods
- Thin bed analysis methods
- Fractured reservoirs
- Thin bed reservoirs in large boreholes (16 and 22") with limited available logging suites

PROSPECT GENERATION

EXPLORATION GEOLOGY
A review of the sedimentology and structural geology of source rocks, reservoirs, seals and traps, to provide a basis for the evaluation of plays and prospects.

PLAY FAIRWAY ANALYSIS
An overview of the petroleum systems and play fairways analysis method, including approaches to risk evaluation on a basin-scale.

HYDROCARBON CHARGE
Source-rock evaluation methods, the hydrocarbon generation process and expulsion and migration mechanisms and timing.

SEALS
The fundamentals of seals, including an assessment of waste zones vs caprocks and methods for evaluating the integrity of fault seals, in preparation for an exercise on fault seal integrity using Allan diagrams.

FAULT SEALS
A detailed evaluation of fault seal integrity for one of the prospects from the hydrocarbon charge exercise, using Allan diagrams to look at the potential for cross fault-flow vs cross-fault sealing, and the potential impact on filling history.

TRAPS AND RESERVOIRS
Classification of structural and stratigraphic trapping styles and important considerations for defining closure and volumes. Local field trip(s) to understand the depositional patterns of the rocks.

GEOPHYSICAL RISKS
A detailed evaluation of geophysical risks covering potential errors relating to closure relief, seismic data density, time-depth conversions, misties and faults, with an example of a risking process for geophysical data evaluation.

PROSPECT GENERATION AND EVALUATION
Reviewing the overall method of prospect appraisal with detailed treatment of volumetrics and risking, including a detailed demonstration of the Monte Carlo method for reserves estimation.

PROSPECT GENERATION AND EVALUATION
Evaluation of a number of maps, well logs and seismic sections to generate a number of prospects. The volumetrics of the prospects will be determined, using the available data and a risking exercise undertaken in order to rank each prospect.

Visit us at www.petroedgeasia.net

Call +65 6741 9927 to enquire or email your query to info@asiaedge.net. Visit us at www.petroedgeasia.net for more information.
### RESERVOIR & GEOSCIENCES

<table>
<thead>
<tr>
<th>Part 1: Structural Geology</th>
<th>Duration: 4 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Structural styles and their importance in HC exploration</td>
<td></td>
</tr>
<tr>
<td>- Migration &amp; trapping</td>
<td></td>
</tr>
<tr>
<td>- Surface &amp; subsurface mapping techniques</td>
<td></td>
</tr>
<tr>
<td>- Structures, isopach, isochore, fault and facies maps</td>
<td></td>
</tr>
<tr>
<td>- Cross-sections</td>
<td></td>
</tr>
<tr>
<td>- Back stripping and analysing structural history</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part 2: Stratigraphy</th>
<th>Duration: 4 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Concepts of Stratigraphy &amp; sequences</td>
<td></td>
</tr>
<tr>
<td>- Law of supposition and application</td>
<td></td>
</tr>
<tr>
<td>- Diagenesis and fractures</td>
<td></td>
</tr>
<tr>
<td>- Different play models</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part 3: SEDIMENTOLOGY</th>
<th>Duration: 4 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Understanding different sedimentary environments and their relations to HC occurrences</td>
<td></td>
</tr>
<tr>
<td>- Clastic &amp; carbonate depositional systems</td>
<td></td>
</tr>
<tr>
<td>- Reservoir quality</td>
<td></td>
</tr>
<tr>
<td>- Facies concepts: analysis, sequence Stratigraphy</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part 4: Carbonate Geology</th>
<th>Duration: 4 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Principles of carbonate sedimentology</td>
<td></td>
</tr>
<tr>
<td>- Integrating well data</td>
<td></td>
</tr>
<tr>
<td>- Different environments and their characteristics</td>
<td></td>
</tr>
<tr>
<td>- Facies concepts</td>
<td></td>
</tr>
<tr>
<td>- Diagenesis and fractures</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part 5: Reservoir Characterisation</th>
<th>Duration: 4 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Introduction to reservoir characterisation tools</td>
<td></td>
</tr>
<tr>
<td>- Integration of core and log data</td>
<td></td>
</tr>
<tr>
<td>- Reservoir properties</td>
<td></td>
</tr>
<tr>
<td>- Fluid properties</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part 6: Reservoir Modelling</th>
<th>Duration: 4 weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Principles of data integration in reservoir characterisation</td>
<td></td>
</tr>
<tr>
<td>- Principles of static modelling</td>
<td></td>
</tr>
</tbody>
</table>

### OTHER ON-THE-JOB PROGRAMMES

#### STRUCTURAL GEOLOGY

- **Introduction to structural geology:** An overview of what structural geology is and the application of structural geology to hydrocarbon exploration, production and development. Structural styles in petroleum exploration.

- **Plate tectonics:** Plate tectonic theory and the evidence for plate tectonics. The composition and rheological properties of the Earth’s plates. The different types of plate boundaries. Plate reconstructions throughout the Earth’s history. The driving forces for plate tectonics. Tectonic settings for sediment accumulation and petroleum provinces.


- **Compressional tectonics:** The development and geometry of thrust faults and their control on fold type. The development of crustal duplexes and imbricate fans. Cross section validation using balancing and restoration techniques. Recognition of folds and reverse faults on seismic cross sections and maps. Cross section construction techniques to interpret sub-surface structure using incomplete data. Mountain belt and foreland basin formation.


#### 3D INTERPRETATION

Looking at direct indicators of hydrocarbons using techniques such as AVO and Seismic Inversion. The focus will be on real hands-on exercises, which should reinforce the contents of the course.

- Tying well data to seismic data; creating synthetic seismograms
- The theory of integrating non-seismic data
- Seismic mapping techniques
- Evaluating structural and stratigraphic traps
- Depth conversion and prospect volumetrics
- The theory of lithological characterisation using seismic data and basic rock physics


- Understanding and quantifying synsedimentary growth sedimentation

---

Training Your Whole Team at a Convenient Time and Location with In-House Training

Call +65 6741 9927 to enquire or email your query to info@asiaedge.net. Visit us at www.petroedgeasia.net for more information.
MAPPING SUBSURFACE STRUCTURES

- Contouring techniques
- Triangulation
- Using dip in mapping
- Different measures of thickness
- Thickness in deviated wells
- Isopach and isocore maps
- Dip-domain cross sections
- Data projection
- Trend and plunge of folds on tangent diagrams
- Composite-surface maps
- Fault shapes and displacement distributions
- Heave and throw from stratigraphic separation
- Stratigraphic separation from structure contour map
- Constructing fault-plane maps
- Faults on isopach maps

SEISMIC INTERPRETATION

This section assumes a basic knowledge of seismic interpretation and concentrates on the role of the seismic interpreter in the search for oil and gas. In addition to workshop exercises focused on the traditional mapping of subsurface structures, we also look at direct indicators of hydrocarbons using techniques such as AVO and Seismic Inversion. The focus will be on real hands-on exercises, which should reinforce the contents of this section.

Module 1: Seismic Data
- Seismic sections on paper
- Seismic data on the workstation
- Well data
- Non-seismic geophysical data
- Special seismic and attribute data

Module 2: Basic reflection theory
- Seismic waves
- P and S waves
- Normal reflection
- Acoustic Impedance, Reflection Coefficients
- Wavelets
- Vertical resolution
- What are the thinnest beds that can be resolved, and how does this change with depth?
- Horizontal resolution
- What scale of features can be seen?
- Borehole seismic measurements and techniques
- Acoustic logs, wellbore seismic
- Seismic review of borehole seismic measurements

Module 3: Acquisition & Processing:
- Acquisition of seismic data
- Prestack processing
- Poststack processing

Module 4: Incorporating Geological information:
- Seismic geology and other geophysical methods
- The integration of well data
- Seismic versus well resolution
- Velocity analysis

Module 5: Picking and mapping horizons
- Choice of reflection
- Following reflections
- Sources of error
- Mapping by hand
- Computer mapping

Module 6: Structural interpretation
- Structural geology terminology
- Classification of structures
- Stress fields (simple strain ellipsoid)
- Seismic interpretation pitfalls (problems)
- Fault plane mapping, including automated fault picking; horizon mapping; strata slicing; zero Vs 90 degree phase; texture analysis.
- Seismic Attribute for Structural Analysis
- Coherency; edge displays; derivative maps; residual analysis; curvature analysis.
- Slip Vs. separation and their quantification
- Subseismic fault prediction

Module 7: Sequence Stratigraphy
- Controls and basic concepts
- Parasequences, parasequence sets and flooding surfaces
- Sequences and systems tracts
- Application of sequence Stratigraphy

Module 8: Seismic stratigraphic analysis
- Recognition of Sequences in Seismic
- A Seismic Sequence Analysis Process Workflow

Module 9: Advanced seismic interpretation techniques:
- Attributes and other techniques can help in the search
- Amplitude analysis and Post-stack amplitude analysis
- Seismic attributes
- Surface attributes
- Other techniques
- AVO
- Impedance inversion
- Geostatistics
- 4D and 4C
- Module 10: depth conversion
- The need for depth conversion
- Rough estimates of depth on seismic data
- Time / depth data from wells
- Time / depth data from stacking velocities
- Integrating both kinds of data
- Exercises and Integrative Case Studies.
ON-THE-JOB-TRAINING

REGISTER YOUR INTEREST

Please contact me for my interest in OTJ training programme on:

- Thin Section Preparation
- Carbonate Sedimentology
- Image Log Interpretation
- Petrophysics
- Prospect Generation
- Reservoir & Geosciences
- Structural Geology
- Seismic Interpretation
- 3D Interpretation
- Sequence & Seismic Stratigraphy
- Nannofossil, Palynology and Palynofacies
- Mapping Subsurface Structures

☐ Please build a programme on the following:-

<table>
<thead>
<tr>
<th>Subject</th>
<th>No. of Trainee(s)</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CONTACT DETAILS

☐ Mr      ☐ Ms      ☐ Dr      ☐ Others:

Name: ____________________________
Job Title: ____________________________
Department: ____________________________
Company: ____________________________
Telephone: ____________________________
Handphone: ____________________________
Email: ____________________________
Address: ____________________________

4 Easy Ways to Register

Online: www.petroedgeasia.net
Email: info@asiaedge.net
Phone: (65) 67419927  Fax: (65) 67478737