



# Applied Biostratigraphy and Sequence Stratigraphy in Oil Exploration & Development

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## Introduction:

**Biostratigraphy** is often run as a service in oil exploration & development for age and palaeoenvironmental interpretation. But the power that can be provided by critical insight of the data generated for detailed sequence analysis including unconformities and sequence breaks plus the identification of flooding and condensed surfaces and its use for facies identification (reservoir to non-reservoir) are often not optimally achieved. Subsequently neither are the desired high resolution stratigraphical correlations.

The integration of biostratigraphical data with seismic interpretations and sedimentological and petrographical data utilizes its power most efficiently. This training course sets out to illustrate this best use. The pitfalls with the use of biostratigraphical data will be discussed, which often relates to the geological context in which formations were deposited. By identifying them and often then utilizing them with regards to understanding the geology, this helps to unlock the tool and with it a realization of the possibilities that optimum use of this technique can bring.

This PetroKnowledge training course will introduce the applied use of biostratigraphy and sequence stratigraphy in both an exploration and development context with working examples from Africa, the Middle East, Southeast Asia and Europe, and will also cover both marine and non-marine sediments.

**This training course will include:**

- An introduction to the different microfossil groups
  - A discussion on the laws of stratigraphy and how biostratigraphy can be used to determine a chronostratigraphy
  - Which microfossil groups to use for which age of sediments and how they are used as palaeoenvironmental indicators
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- What pitfalls to look for and how these can lead to a better geological understanding
  - How to use biostratigraphy and bio facies to identify key seismic markers
  - How to integrate biostratigraphical data with other geological data (sedimentological, petrographical, geochemical) to maximize its use
  - How to use integrated biostratigraphical data to build a high-resolution sequence stratigraphy
  - How biostratigraphy can be used in play definition and for play based exploration
  - Working examples of applied stratigraphy for exploration and development from Africa, Asia and Europe

## **Objectives:**

**By the end of this training course, participants will be able to:**

- Have knowledge of the different microfossil groups and in which ages of sediment and palaeoenvironment of deposition they can be utilized.
- Develop an understanding of how biostratigraphical data can be integrated with other geological data to optimize its use as an interpretative tool

- Develop an enhanced interpretation skill to recognize key seismic markers and how to interpret these as a geological sequence by integrating biostratigraphical data
- Interpret palaeoenvironment of deposition by using biostratigraphical assemblages
- Use biostratigraphy as a predictive tool in exploration and development

## Who should attend?

This BTS training course is suitable for exploration and development geologists, seismic interpreters, sedimentologists, petrographers and other upstream subsurface professionals who are interested in optimally utilizing geological data as a predictive tool in sedimentary basins and for identifying hydrocarbon plays in active petroleum systems.

## Course Outline:

### Day One: Stratigraphy and an Introduction to Micropaleontology

**Competency Description:** Understanding the fundamental laws and principles of stratigraphy and biostratigraphy including preparation techniques and an appreciation of all the fossil groups and their stratigraphical ranges.

### **Key behaviours**

- Understand and apply key technical laws and principles
- Apply and use relative versus absolute age dating mechanisms
- Apply chronostratigraphy the under-used tool in exploration
- Discover all the microfossil groups and what their age ranges are and their palaeoenvironmental of deposition

### **Topics to be covered**

- The laws of Stratigraphy
- Age dating methods for sediments and igneous rocks
- The stratigraphical column and chronostratigraphy
- The different microfossil groups and preparation techniques
- Organic microfossils (Palynomorphs) including Acritarchs, Chitinozoans, Dinoflagellates, Pollen and Spores
- Inorganic microfossils including Microforaminifera and Ostracoda

## Key behaviours

- Prepare and present biostratigraphical data
- Prepare biostratigraphical range charts
- Understand the use of numerical methods in biostratigraphy
- Develop knowledge of how to select which samples and which microfossils should be analysed in a biostratigraphical study
- Learn how to identify index fossils
- Identify which microfossils can be found in which sediment type and of what age

## Topics to be covered

- Microfossil evolution through the stratigraphical column
- Building stratigraphical range charts
- First downhole occurrence, last downhole occurrence, fossil assemblages
- Numerical methods, frequency polygons, abundance increases and maxima

## Day Two: Biostratigraphy

**Competency Description:** How to present and interpret biostratigraphical data and understanding the relationship between biostratigraphy and chronostratigraphy.

- Index fossils
- Stratigraphical type sections and the relation between biostratigraphy and chronostratigraphy

### **Day Three: Biostratigraphical Correlations and Correlation Techniques**

**Competency Description:** How to prepare well to well correlations using biostratigraphical data, how to integrate it with other geological data and how to identify and discount spurious or misleading information to optimize the interpretation method.

#### **Key behaviours**

- Understand how to generate a biostratigraphical cross section
- Recognize the pitfalls in the use of biostratigraphical data
- Learn how to define a biozonation
- Finding out how best to integrate other geological data
- Discover the relationship and how to integrate geochemical information

### Topics to be covered

- Building a biostratigraphical cross section, datum selection
- Pitfalls using biostratigraphical data, downhole caving, reworking, contamination
- Definition of biozones
- Integration of sedimentological and petrographical data
- The integration of geochemical information
- Identification of unconformities / hiatus in the sequences

### **Day Four: Biostratigraphy, Paleoenvironment's and Seismic Sequence Stratigraphy**

**Competency Description:** Using microfossils to identify the palaeoenvironment of deposition, using biostratigraphical and palaeoenvironmental information to identify sequences and sequence boundaries and its integration into a seismic sequence stratigraphy and using biostratigraphy in appraisal and development situations.

### **Key behaviours**

- Discover the use of microfossils as palaeoenvironmental indicators
- Use biostratigraphical data to identify sequences and to determine a sequence stratigraphy
- Integrate biostratigraphical data with well log data to identify unconformities, hiatuses and sequence boundaries
- Develop seismic interpretation skills of sequences for optimum resolution using fully integrated geological data
- Discover the use of biostratigraphical techniques in appraisal and development situations

### **Topics to be covered**

- Using micropalaeontology for palaeoenvironmental interpretation
- Marine microfossils versus non-marine microfossils
- Preservation of microfossil groups and different lithology's
- Definition of water depth from the different fossil groups
- The identification of sequence boundaries using biostratigraphical data
- Using biostratigraphical data to identify condensed sequences and maximum flooding surfaces

- Using biostratigraphical data to identify lowstand system and high stand system tracts
- Integration of biostratigraphical data and seismic sequence stratigraphy
- The pitfalls, understanding the resolution related to the geology and the limitations

#### **Day Five: Play Definition using Play Based Exploration Techniques and Examples of the Use of Biostratigraphy in Exploration and Development**

**Competency Description:** Learning and applying play-based exploration techniques and the integration of biostratigraphy using real working examples from Libya, Egypt and Thailand and how to use these techniques optimally in active exploration and appraisal situations.

#### **Key behaviors**

- Discover the use and the application of play based exploration techniques
- Understand the practical use of play based exploration and integrated biostratigraphy using real working examples
- Develop skills in the application, interpretation and knowledge of the restrictions in different plays of different ages
- Practice by using real examples to integrate biostratigraphical data and then understand how this can be used in play through to prospect definition

### **Topics to be covered**

- Hydrocarbon play definition – what is a play
- Integrated biostratigraphy and its use in Play Based Exploration techniques
- The Kalash Formation a Late Cretaceous shelfal carbonate play NW Sirt Basin, Libya
- The Kareem Formation a sub marine Miocene fan play, Gulf of Suez, Egypt
- A Middle Miocene lacustrine fan/delta play, Kra Basin, Gulf of Thailand, Thailand
- Examples of the use of biostratigraphy in development in Libya, Thailand, Ivory Coast