Training course: Applied Biostratigraphy: A Critical Tool for Subsurface Prediction & Characterisation

Course Content

1. Characterising and Predicting the Subsurface – What do we need to Understand and Why? How Does Biostratigraphy Help?

We will begin the course with the observation that the subsurface has never been more in demand. Not only do we need to find physical resources such as oil, gas, and water, we need to store carbon dioxide, hydrogen, and locate geothermal energy. We need to successfully plan and execute geoengineering for energy transition infrastructure. All of this requires an understanding of the geology of subsurface, leading to accurate prediction and characterisation. Biostratigraphy (the applied use of fossils) is one of the tools routinely used to develop the geological understanding required. We will discuss how and why this is so to set the scene for the rest of the course.

2. Correlation – The Cornerstone of Successful Subsurface Understanding

Whilst information from geophysical methods allows us to visualise the subsurface in increasing amounts of detail, plausible and accurate interpretation requires rock units to be correlated from one location to another. Are two porous sandstones in two different wells the same rock unit or different units? How does a shallow marine limestone at one location relate to a deep marine shale at another? We will explore how biostratigraphy helps answer these questions using biozones and bioevents, with practical exercises based on data from the Middle East and the North Sea.

3. Depositional Environments – Insight into the Architecture of the Subsurface

The sedimentary architecture of rock units is strongly controlled by their depositional setting, so an understanding of this is a fundamental aspect of subsurface characterisation. As with modern-day organisms, different fossils inhabited different environments, meaning that their analysis can provide useful insight into depositional settings and their vertical and lateral trends.

3. Depositional Environments – Insight into the Architecture of the Subsurface (continued)

This in turn can be used to characterise reservoirs and storage units. We will provide an overview of the uses and limitations of biostratigraphic data in supporting this analysis with a global set of examples.

4. Sequence Stratigraphy – An Integrated Approach to Subsurface Prediction

Sequence stratigraphy integrates several data types and methodologies (geophysics, sedimentology, biostratigraphy, etc) and is predictive, it has been adopted by many geoscientists as a cornerstone of subsurface interpretation. As the technique requires an understanding of age/correlation and of trends in depositional setting, biostratigraphy is essential for its correct application. We will use exercises based on real-world data from the Middle East and Gulf of Mexico to explore the concepts and develop predictive outcomes that have value across the energy transition.

5. Choosing the Right Tool – Which Fossils for Which Rocks?

Whilst this course is about understanding the uses of biostratigraphy rather than details a subject matter expert is concerned with, it is useful to know that there are a variety of (micro)fossil groups used in the subsurface, meaning that no matter the age or depositional setting of many rocks, there are fossils useful for each. We will briefly discuss this and carry out a simple exercise to illustrate the concepts.

6. Real-time Biostratigraphy – Its Uses at Wellsite

In the last few decades, practical applied biostratigraphy has enjoyed a renaissance thanks to its use at wellsite to assist in real-time drilling decisions that can generate millions of dollars of value and greatly enhance the safety of wellsite operations. Such applications range from assisting in decisions to stop drilling, set casing points, and to assist in steering well trajectories into their optimum pathways. We will explore these uses with a hands-on exercise that mimics the wellsite experience using data from the North Sea.

7. Summary – The Use of Biostratigraphy Across the Energy Transition and Beyond

Having explored the diverse applications of biostratigraphy in understanding the subsurface, we will conclude with a summary of the way in which these techniques can be applied across the energy transition – in resource exploration, in storage definition, and in geoengineering, with a series of real-world examples.