Modern Well Log Interpretation

Course Price

£3050

Course Description

A five-day classroom course, with many individual exercises.

The course comes in two “flavours” depending upon the background of the participants. The first three days cover all standard and modern well-logging measurements both Wireline and LWD, and the remaining two days cover specific topics as follows:

+ a “geological” flavour covering dipmeter/imaging logs, use of logs for correlation, mineralogy
+ an “engineering” flavour covering cased-hole topics such as bond- & corrosion-logging, fluid level monitoring, perforation performance issues.
+ depending on participants’ background and interest, a number of more advanced topics can be presented in the form of overviews; details are in the course content summary below.

Course Objectives

Successful completion of the course will give participants a good understanding of the basic logging measurements and interpretation methods, sufficient to assess log quality and identify data acquisition problems, and to perform their own simple log interpretations in clean formations. The more complex topics covered towards the end of the course will give insights into the use of new measurements and will discuss the issues involved in making interpretations in complex geological environments.

Who Should Attend

This course is intended for entry-level engineers and geologists/geophysicists, as well as for experienced geo-scientists and technical assistants working with, or needing to understand better, the principles of log interpretation and/or to update themselves on the range of log measurements and techniques now available to them.

Although the course is appropriate for both engineers and geologists/geophysicists, the emphasis and level can be changed depending upon the participants’ requirements and backgrounds.
Course Content

Training Method and General Remarks

This course presentation is modular and covers the topics listed below, using many generic examples for the participants to work on themselves as each topic is covered. Participants develop their own interpretation of 2 sets of logs (one wireline, one LWD) as the course progresses, and (most of) the last day is taken by working in teams on a further set. If possible, the latter example will be chosen from the area of the course (We have examples from Gulf of Mexico, Alaska, India, Nigeria, Kazakhstan & the North Sea).

Although the course concentrates mainly on wireline measurements, equivalent LWD measurements are also covered, remarking upon the differences and their advantages/disadvantages, with examples. The range of measurements discussed is comprehensive, so participants are also presented with an up-to-date “shop window” of the wireline & LWD tools & techniques now available to the industry.

Great emphasis is placed on the fact that log interpretation is still largely based on empirical relationships, the applicability of which may depend on local factors, and course participants are constantly reminded that reliance on “black box” interpretation methods can lead to serious misinterpretations. Thus, the computers provided for the course are largely there to enhance the speed of computation of the data points manually chosen by the participants, using a simple Excel spreadsheet program implementing standard relationships, rather than for pushing un-screened log data through a pre-set interpretation package.

Efforts are also made broadly to cover the technologies offered by the various different service vendors, rather than only those from a single supplier.

Documentation

The course handouts include a hardcopy manual, exercises and a CD with the worked course examples and a selection of standard texts on log interpretation:

Log Interpretation Charts (Halliburton)

NMR Logging Principles & Applications (Halliburton)

Log Interpretation Openhole & Cased Hole Principles (Schlumberger)

Log Interpretation Chartbook (Schlumberger)

Introduction to Wireline Log Analysis (Baker Atlas)

Day 1

General Topics and Resistivity Measurements

1. Brief Overview of Requirement for Wireline & LWD Measurements
2. Overview of Basic Petrophysical Models & Relationships Used in “Clean” formation interpretation

3. Overview of Basic Geological Models & Signatures obtainable from well logs or

4. Overview of Basic Geological Models & Signatures obtainable from well logs

5. Overview of Basic Applications of Wireline & LWD Methods for Well Completions (Geoscientists and/or Reservoir Monitoring (Engineers)

6. Depth Measurements & Control

7. Conductivity in Electrolytes and Derivation of Rmf at Formation Temperature

8. Use of SP for Geological Interpretation and to determine Rw

9. Resistivity Measurements to Determine Rt , Rxo and invasion profile

Tornado chart corrections & implications of the “step-profile” and other invasion profile assumptions

10. Gamma Ray

11. Caliper Measurements

12. Identification of Potential Zones of Interest using SP, GR and Resistivity

[This section is mainly the participants working through a series of log examples to illustrate the selection of zones of possible interest]

**Day 2**

**Porosity and Mineralogy/Lithology Measurements**

13. Measurements for Determination of Porosity & Mineralogy/Lithology

   - Density Measurements
   - Neutron Measurements
   - Acoustic Measurements
   - Pe Measurements
   - Crossplot methods for porosity & lithology determination

14. Gamma Ray Spectrometry and Core Sampling for Enhanced Mineralogy Determination

   - Spectral Gamma Ray
   - Elemental Capture Spectrometry
   - Percussion & Mechanical Sidewall Coring

**Day 3**

**Linking Resistivity with Porosity/Mineralogy Measurements**
15. Linking Porosity, Formation Factor and Water Saturation

16. Determination of Water Saturations in Virgin and Flushed Zones

17. Completion & review of 1st example set of logs (“Clean Sand” example) which the group has been working on in teams over the first 3 days. Review of GoM LWD set of logs (“Homework” example) given to participants for their study after course hours.

**Day 4**

**Miscellaneous Measurements for Petroleum Engineering and Geological Applications**

18. Pressure Measurements, Fluid Sampling & Analysis using Formation Testers

19. Nuclear Magnetic Resonance Measurements

20. Permeability Determination from Logs & Pressure Measurements

21. Overview of Computer Log Interpretation Methods

Alternative Topics for Geologists’ Course:

22. Other Geological Applications of Resistivity, Porosity & GR Spectrum Measurements

Discussion of examples & applications

Alternative Topics for Engineers’ Course:

23. Cased-Hole Logging Measurements

**Day 5**

**Log Quality Control, Interpretation of Final Example**

24. Overview of Some Log Quality Control Issues

25. Participants work in groups on 2nd example set of logs, preferably from general area of course, otherwise using a standard example from the North Sea (“Forties” example)

26. Review of interpretation of 2nd set of logs, final summary and prize-giving, award of certificates

Other Topics on Special Request, or as Time Permits:

27. Overview of Dipole Sonic Measurements

28. Electromagnetic Propagation Measurements

29. Overview of Shaly Sand Interpretation
30. Overview of Log Interpretation in Thin Sand/Shale sequences

31. Overview of Log Applications in Shale – Oil/Gas Formations

32. Overview of Log Interpretation in Complex Carbonate Reservoirs

33. Overview of Different Approaches to Cement Bond Evaluation

34. Overview of Production Logging in Horizontal Wells

Participants will also be expected to do about an hour of “homework” each evening.

CPD Unit

Continuing Professional Development

35 HOURS CPD