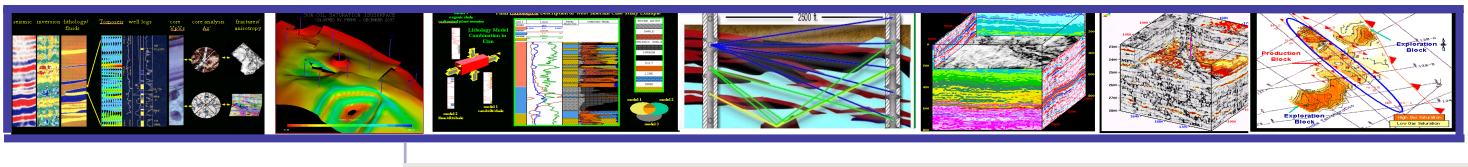
KMS Technologies

Innovating Solutions

Reservoir characterization with borehole geophysics

Training course



Course description

This course is building the bridge between well logging, formation evaluation and geophysical reservoir characterization. It includes basic rock properties and brings back complicated technologies to first principles such that the course participants can remember how to understand modern complex logging and reservoir monitoring technologies

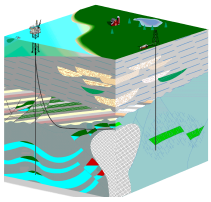
When optimizing the recovery factor of hydrocarbon reservoirs, integration between borehole measurements and surface measurements is crucial to understand the scale limitation of the surface data and also the limitations of borehole data, as it is being use for calibration. Borehole geophysics builds that link between rock physics, well logging and surface seismics leading to characterization of the reservoir on the reservoir scale.

The basis for borehole measurements is obtained from a basic understanding of rock physics. The understanding of the physical properties of rocks and their importance for the different applications such as petroleum or engineering makes up the basic framework for the methods. The understanding of the influence of these parameters leads to petrophysics in the oil field environment and immediately to the appropriate Earth models. We then design geophysical techniques (seismic, gravity, electromagnetic) to measure these Earth models and to get a better insight into the reservoir. Borehole seismics, which covers most of borehole geophysics, can be separated into three groups: Vertical seismic profiling (VSP); cross well and single well techniques; and fracture monitoring. All techniques have different user groups and objectives in petroleum geophysics. VSP is mostly used for direct calibration between logs and seismic with 3D VSP going a little bit further into the structural definition of the reservoir. Cross well and single well techniques link the well and are mainly used to investigate the interwell space. Fracture monitoring allows optimizing the artificial fracture stimulation (active) and reservoir production (passive) process. Both are geared to optimized production and well placement.

Additional elements of borehole geophysics are borehole gravity and borehole electromagnetics. Gravity is used to investigate density contrasts up to 200 m away from the well bore and borehole electromagnetics can spanned up to 500 m in cross well mode. Borehole gravity has been commercial for over two decades and borehole EM is just now emerging.

To better understand how this link with well logging, the course will review key logging techniques namely nuclear, electrical , acoustic , nuclear, and NMR logging and image logs. Other logging methods will only be shortly introduced. Finally, we will conclude with several special topics (Permanent sensors, geosteering and NMR for mud logging). Throughout the logging section, emphasis is given of to the integrative nature of the different logging methods.

The course has been taught since 2000 at many universities in the USA (Houston), China (Yangtze), Europe (Bonn), India, Thailand and many companies.



KMS Technologies

KJT Enterprises Inc.
6420 Richmond Ave., Suite 610
Houston, TX 77057
USA

Tel: +1.713.532.8144

Email: info@KMSTechnologies.com
www.KMSTechnologies.com

Course material and requirements

The course will provide a course website with the lectures and supporting downloads: literature, free software and previous course results (term papers etc.). Course participants will receive a password and user name. In addition the following textbooks are recommended.

Hardage, B.A., 2000, Vertical seismic profiling, Handbook of Geophysical Exploration, Helbig, K. & Treitel, S (eds), 14, Pergamon, 352pp.

Luthi, S.M., 2000, Geological well logs: Their use in reservoir modeling, Springer, 377pp.

Schön, J.H., 1996, Physical Properties of Rocks: Fundamentals and Principles of Petrophysics, Handbook of geophysical exploration - seismic exploration, K. Helbig & S. Treitel (eds.), 18, Pergamon Press (second edition 2004).

Course outline

Introduction
- The critical link

Rock Physics Overview
- Pore space properties
- Density of rocks
- Natural radioactivity of rocks
- Elastic properties
- Anelastic properties
- Electrical properties
- Correlations between properties

Seismic methods
- VSP
- Crosswell
- Single well
- Microseismic monitoring
- Seismic while drilling

Field equipment
- Sources and sensors
- Noise sources
- Tube wave suppression example

VSP Processing
- Basic processing
- Identification of reflectors
- Looking ahead of the bit
- 3D SWD

BHS applications
- SWD during tunnel boring
- Fracture monitoring
- Cross well tomography ….
- Single well methods
- 3D VSP
- VSP for engineering applications

Borehole Electromagnetics
- The methods
- Cross well EM
- Single well EM
- Seismoelectric measurements

Borehole gravity
- Gravity principles & examples
- BHGM & Gradiometers
- Permanent sensors

Logging
- Overview
- Mud logging (NMR)
- MWD/LWD Q. LI
- Natural Gamma ray tools
- Borehole imaging
- Resistivity logs
- Sonic logs
- NMR

Geosteering

Permanent sensors
- Overview
- Seismic sensors
- Density sensors
- Electrical sensors
- Reservoir monitoring applications

The future
- Market trends

