Leon H. Charney School of Marine Sciences
UNIVERSITY OF HAIFA

Practical petrophysics and logging – 2 credits

Course Number: 224.4999

Lecturer: Prof. Nicolas Waldmann

Office Hours: Monday 12:00-14:00, Multipurpose Building – Room 130, tel. 048280736

Course Type: Lecture

Course Level: MSc

Prerequisites: No

Course Description:

Well logging provides data to answer fundamental questions regarding petrophysical, geological, and mechanical properties of the subsurface, which are highly important in better comprehending the geological history and required to evaluate, develop, and produce a hydrocarbon-rich basin. The course covers fundamental petrophysical concepts and equations. The following well logging measurements are discussed: resistivity, natural gamma radiation, neutron porosity, density, photoelectric absorption, acoustic/sonic, nuclear magnetic resonance, and formation pressure. Selected topics from well data acquisition methods and the interpretation of these data are included as well. The course will cover an integration of data from well logs, core analysis, and surface logging as well as understanding petrophysical concepts and models. We will learn about the properties of clay and shale and how water saturation models influence shaly formations. Advanced well log measurement techniques including nuclear spectroscopy, nuclear magnetic resonance, tri-axial induction, dielectric dispersion, and borehole imaging. Fluid analysis and sampling. Introduction to cased hole logging.

Topics:

1. Fundamental petrophysical concepts and equations.
2. How does the composition of the rock influence the measurements we do and important petrophysical parameters like porosity, permeability and saturation.
3. Boreholes measurements: Resistivity, natural gamma radiation, neutron porosity, density, photoelectric absorption, acoustic measurements, formation pressures, nuclear magnetic resonance and more.
4. The measurement environment in a borehole and environmental corrections of the data.
5. Find how the measured properties can be used to determine the porosity, permeability, water/hydrocarbon saturation, shale content and rock type.

Learning Outcomes:

At the end of the course, students will be able to:

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1. Make simple interpretations of the more common log measurements that are made in a borehole.
2. Determine the main lithologies and estimates of porosity, saturation and permeability, and which fluid types, water, oil or gas, are present in the formations.
3. Work with real data from the field and understand that the data can be uncertain.
4. Understand fundamental petrophysical concepts and equations as well as to be able to interpret how does the composition of the rock influence the measurements (porosity, permeability and saturation).

Requirements: Lectures and group work. Compulsory exercises. Lectures are given in English. Lectures will be given online (zoom) in case it is required.

Grading: Exam + 85% of the exercises and quizzes.

Reading List:

1. Cannon, S., 2015. Petrophysics: a practical guide. John Wiley & Sons.
2. Tiab, D. and Donaldson, E.C., 2015. Petrophysics: theory and practice of measuring reservoir rock and fluid transport properties. Gulf professional publishing.
3. Yang, S. and Wei, J., 2017. Fundamentals of petrophysics. Springer Berlin Heidelberg.