

Petrophysical multimineral analysis

Instructor: Patricia E. Rodrigues, PhD.

Course description

Deterministic petrophysical workflows have been successfully applied for decades for the petrophysical characterization of hydrocarbons reservoirs. The application of these workflows to areas of complex lithologies in conventional or unconventional reservoirs has been challenging because traditional models and concepts are not always valid or applicable. Multimineral analysis offers an alternative to conventional petrophysical modeling in areas of complex lithologies.

The advantages of multimineral analysis go beyond improving the petrophysical solution in areas of complex lithologies. A multimineral solution can aid communication with professionals from other disciplines that are less familiar than a seasoned petrophysicist with the interpretation of raw logs. However, multimineral modeling is underutilized and considered by many as a “mysterious” and difficult tool to use. Even though commonly used commercial petrophysical packages have the capability to perform multimineral analysis, it still is rarely used. Besides, it is usually cumbersome to run and a typical complaint from users is that “it always generates a solution that looks reasonable but too often doesn’t make geological sense”.

This training uncovers the mysteries of the multimineral solution. It is centered on explaining the basic concepts, understanding the mathematical uncertainties, and exploring the implementation of the technique to ensure not only a good mathematical solution but also a reasonable, useful geological one. This is not a software training class; it is a conceptual class. Although we utilize the iMineralysis® software to explore concepts, attendees will not emerge from the class as users of any specific software.

Course Content

This course explains the basic concepts, assumptions, calibration, and implementation steps needed to obtain reliable results. Exercises emphasize the importance of data preparation for calibration and sensitivities of the tool to different parameters. Modern, commercial applications are also discussed. Exercises will be based on the tool iMineralysis® which will be licensed to participants at no cost for the duration of the class.

- **Review of deterministic methods and comparison to multimineral analysis**

To introduce the class, we review some of the traditional petrophysics concepts, also known as deterministic techniques. Then, we introduce the concept of multimineral analysis and inversion and contrast the methodology to the deterministic approach, exploring its advantages and applications.

- **Types of calibration data and data preparation**

The second part focuses on calibration data. In this section we discuss the kind of data we can use before and after the process to ensure sound geological solutions; we also explain in detail how mineralogy data need to be transformed to be used in quantitative calibration. This section is complemented with exercises to solidify concepts.

- **Multimineral analysis fundamentals: equations, assumptions, limitations, and solution**

The next two sections of the class explain the mathematical concepts behind the multimineral solution. The intent of these sections is not for class participants to learn how to solve the mathematical problem but to understand how the log data and mineral volumes are treated in the solution. This understanding will allow users to make the right decisions when setting up the problem and adjusting parameters to improve the solution.

- **Modeling process: uncertainties, mineral blends, tips for successful implementation**

In this section, we discuss implementation issues, tricks, and tips to ensure a successful application of the method. This section is built on the years of the experience of the instructor successfully implementing the technique in many basins with different datasets.

- **Advanced multiminerall solution: use of genetic algorithms, advantages, and limitations**

The final section discusses a groundbreaking technique included in the iMineralysis® software using artificial intelligence to aid in the search for a useful multiminerall solution. We'll use the software to explore the concepts presented in the implementation section.

Who Should Attend?

This class is suited for geoscientists and petrophysicists who would like to better understand or incorporate multiminerall analysis in their tools to improve the characterization of complex lithologies in conventional and unconventional reservoirs. It is also suited for geologists, geophysicists interested in rock properties, and engineers with knowledge of basic petrophysical concepts who would like to understand the applications and limitations of multiminerall analysis.

Prerequisites (Knowledge/Experience/Education required)

Knowledge of basic logs and petrophysical concepts is highly recommended.

Technical requirements

- Excel (or Excel Online)
- Administrator access to install the iMineralysis® software before the class. Installation instructions are sent after registration.
- Camera and microphone are highly recommended to improve class interaction.

Instructor Bio

Patricia Rodrigues received a Ph.D. in geophysics from Colorado School of Mines and a B.S. and M.S. in chemical engineering from Universidad Simón Bolívar (Venezuela). She is an expert on multiminerall analysis and has taught this class at Colorado School of Mines for seven consecutive years as part of the Advanced Petrophysics class. She has more than 20 years of experience in research and application of reservoir characterization technologies, specializing in petrophysics and rock physics for the oil and gas industry. She worked 8 years for PDVSA-Intevep and two years for Tricon Geophysics on seismic petrophysics and integrating well data through rock physics methodologies. In 2006, she joined DRM Energy Corp., a startup oil and gas company, while she also worked for iReservoir as a senior petrophysicist. After iReservoir, she went back to school to complete her Ph.D. while working part-time for Newfield Exploration Company. In 2014, she joined Whiting Petroleum where she has been Chief Petrophysicist and, more recently, Director of Geology and Geophysics. Patricia has served the Denver Well Log Society as VP of Technology, President, and currently Past President. For more details, click [here](#).