

Introduction to geophysical methods

Professor: José M. Carcione
email: jcarcione@libero.it

Course objectives

The course covers the basic theory of seismic waves, data acquisition, processing and modeling-tomography based interpretation of seismic data to obtain a structural map of the Earth and its geological and petrophysical properties. Other techniques are outlined, such as electromagnetic (EM) methods. The overall objective is to introduce professionals to the key concepts and principles that form the basis of geophysical techniques, mainly seismic-based methods. The practical applications are covered with many examples, such as evaluation of methane hydrate content, upscaling techniques, detection of overpressure, propagation in permafrost, exploration of the Earth's deep crust, time-lapse seismics for monitoring CO₂ injection, borehole stability, the mesoscopic loss mechanism in reservoir rocks, geo-radar applications, low-frequency electromagnetic prospecting in the Earth, etc.

On completion of the course, participants will be able to:

- Understand the physics of seismic (and EM) wave propagation in reservoir and source rocks.
- Understand the different methods used for seismic prospecting of hydrocarbons.
- Extract useful petrophysical information from geophysical data, such as rock type, porosity, fluid saturation, pore pressure, fracture orientation, permeability, etc.

Course content

Seismic (and EM) fundamentals

P and S wave propagation
Reflection (AVO), refraction and transmission
Rock physics based on poroelasticity
Seismic attributes
Anisotropy and attenuation
The acoustic-EM analogy

Methods

Modeling techniques – Synthetic seismograms
Multifold seismic data acquisition on land and off-shore
The CMP method and the seismic-processing workflow.
Modeling-inversion based interpretation
The georadar and EM techniques

Duration: 5 days, 5 hours per day.

Language: Spanish, English or Italian