GEOSCIENCES
Reservoir Geology

E-310

▲ Who should attend?

All geoscientists (geophysicists, geologists, reservoir engineers) who wish to widen their knowledge on the wave propagation in porous media, nearer to reality in order to obtain a full understanding of what occurs in the reservoirs when those are seen through the seismic technique, and when the assumption of elastic medium does not hold any more (being able to call into question the equations of Zoeppritz in AVO, or giving access to new techniques within the framework of active or passive reservoir monitoring.

▲ Duration

5 days

▲ Dates & Location

December 14-18, 2009
Rueil-Malmaison (Paris)

French session: F-310

▲ Registration

Fees: **€ 2,070**

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Ref. **RES / WAVEPOR**

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ACOUSTIC AND SEISMIC WAVE PROPAGATION IN POROUS MEDIA

COURSE OBJECTIVES

To provide a broad and intuitive understanding of seismic concepts and methods having to be used when the medium surrounding the reservoir and/or the reservoir should not be considered any more as elastic but porous.

On completion of the course, participants will be able to:
- interact competently with their colleagues to make the appropriate choice and decision when the seismic target is in near surface, or in depth during acquisition, processing and interpretation projects,
- have practical and effective methods to define rock physics models making the link between cores, logs and seismic data for a better exploiting of their specificity,
- follow recent developments in seismic techniques applied on reservoir characterization and monitoring.

COURSE CONTENT

INTRODUCTION - RECALL ON THE WAVE PROPAGATION — 1 day

Importance of porous medium, mainly in petroleum industry - Seismic: a tool and a link for the reservoir engineer
Wave propagation in elastic medium: fundamental assumptions and theory, Newton's and Hooke's laws
Wave propagation in porous medium: porosity, permeability, viscosity, Notion of coupling between solid and fluids, introduction to the Biot type model, Gassmann model

SEISMIC WAVE PROPAGATION - FURTHER INFORMATION — 0.5 day

Elastic medium: dispersion, phase, group, energy velocities, attenuation, impedance, reflectivity, AVO
Porous medium: dispersion, phase, group, energy velocities, attenuation and Q factor, impedance, reflectivity, AVO

MECHANICAL MODELING - VISCOELASTIC MODELS — 0.5 day

Rheological models: Maxwell's model, Kevin-Voigt's model, standard linear solid or Zener's model
Nearly constant Q model, constant Q model, Kramer-Kronig relations

SCALE FACTOR BETWEEN CORES - LOGS - SEISMIC — 0.75 day

Upscaling/Downscaling: seismic scale, log scale, core scale
Heterogeneous media: recall of some definitions: effective stress, confining stress, pore pressure,
Biot coefficient, differential pressure, effective dry compressibility, Skempton's coefficient
Lab measurement: pressure and temperature impact on elastic and petrophysical parameters
Log measurement (cores vs logs scales), Seismic measurement (logs vs seismic scale)

HETEROGENEOUS MEDIA THROUGH THE ACOUSTIC WAVES — 0.25 day

1D heterogeneity - layering media: layer thickness, wavelength impact
2D / 3D heterogeneity: Fresnel zone impact

ANISOTROPIC MEDIA AND EFFECTIVE MEDIA — 0.75 day

Anisotropic media: Backus average, weak elastic anisotropy, Thomsen notations, AVO
Effective media: dry rock, saturated "drained" rock, saturated "undrained" rock, Hashin-Shtrikman model
Reuss & Voigt models, Berryman model, Hill's relation, differential effective medium model (DEM)

ROLE OF FLUID IN HETEROGENEOUS MEDIA(POROUS MEDIA) — 0.75 day

Role of fluid: Gassmann's theory and model, different fluid mixing law, impact on elastic parameters
Composite porous media: generalized Gassmann's equation, critical relaxation scale,
Differential models: Biot global flow mechanism, Geertsma-Smit approximations,
Squirt or local flow mechanism, patchy saturation model

EMPIRICAL RELATION AND SOME APPLICATIONS — 0.5 day

Empirical relationships: Geertsma, Wyllie, Raymer, field observation transform
Applications: AVO, reservoir description: pressure and saturation, lithology and fluid content, Q factor and flux theorem, GWC monitoring