GeoNeurale

INTEGRATING GEOSCIENCES

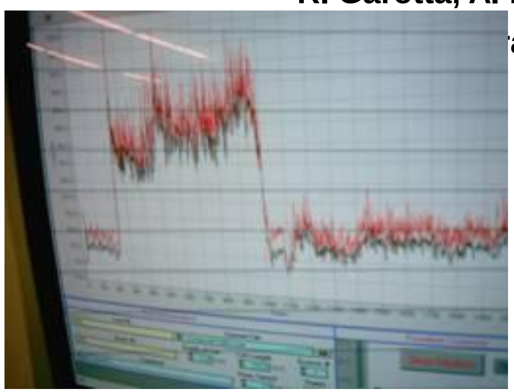
in

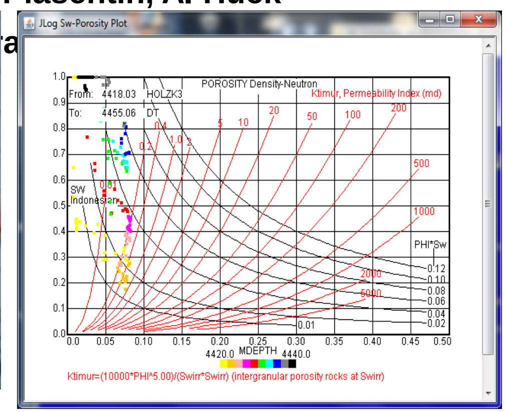
PETROLEUM EXPLORATION

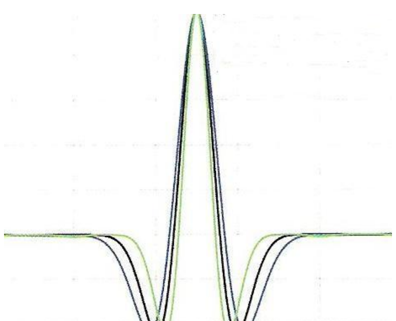
A detailed course on the main disciplines involved in the oil&gas exploration.

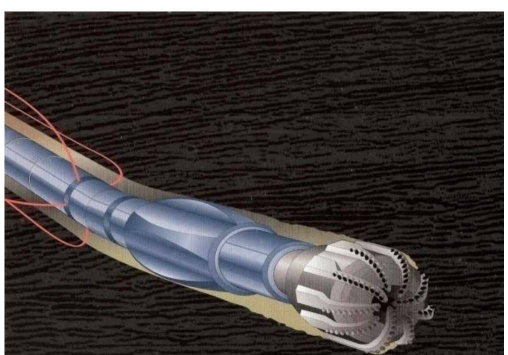
A training on project supervision and multidisciplinary communication for professionals of the oil industry.

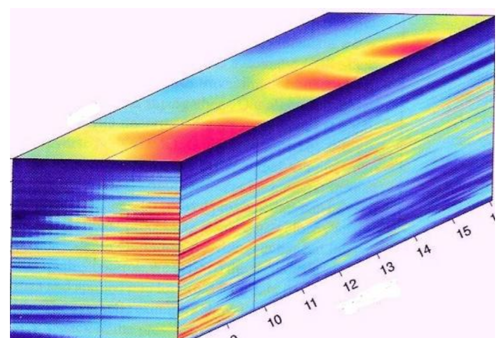
R. Garotta, A. Piasentin, A. Huck

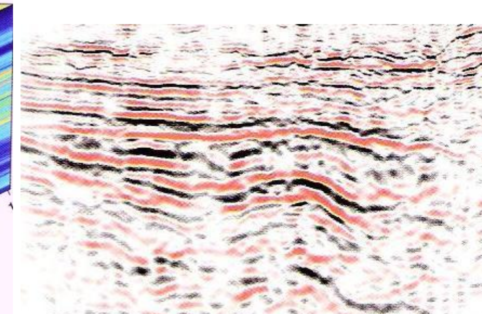












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03-08 December 2018 **(6-days course)**

GeoNeurale – Training

Fürstenfeld 12
82256 Fürstenfeldbruck - München
Germany

6 DAYS INTENSIVE TRAINING

INSTRUCTORS: Robert Garotta, Angelo Piasentin, Arnaud Huck

A N INTERDISCIPLINARY COURSE FOR EXPLORATION AND PRODUCTION PROFESSIONALS

AUDIENCE: Geophysicists, Static Model Specialists, Petrophysicists, Geologists, Reservoir Engineers, Geoscientists, Engineers, Managers.

LEVEL: Intermediate to Advanced

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This is an 6-days intermediate to advanced course mainly addressed to crossdiscipline geoscientists, engineers and decision managers of the oil exploration industry.
The involved theories are particularly useful to static modeling specialists and professionals for supervision on micro to macro-field data, for control, calibration, upscaling of 3D static and dynamic models. The program is an ideal complementary part for other advanced courses as: Seismic Interpretation, Seismic Attributes Analysis, Seismic Processing, 3D Multicomponent Seismic. An important overview on disciplines for the plan and management of exploration projects.

COURSE PREPARATION

Online Propedeutical course preparation is available at request and comprises the following topics:

-Basic Applications and Algorithms
-Introductory elements of Petrophysics
-Introductory elements of Seismology

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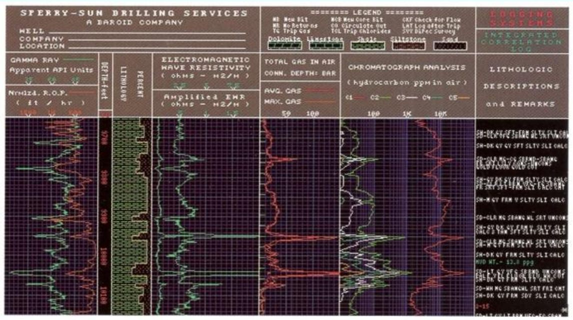
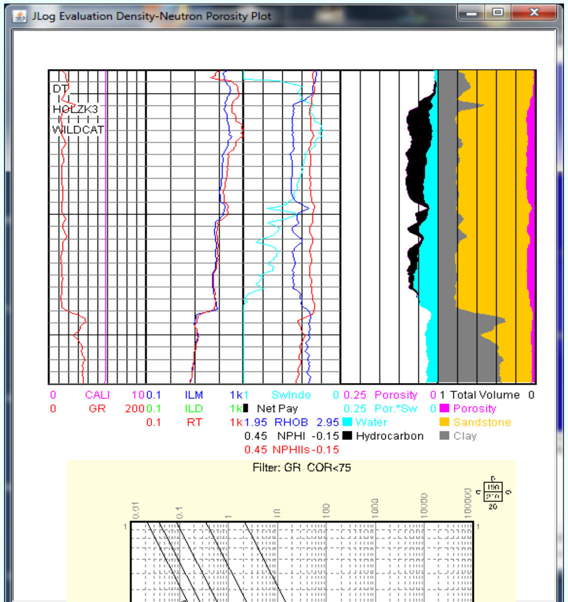
Forum Fuerstenfeld

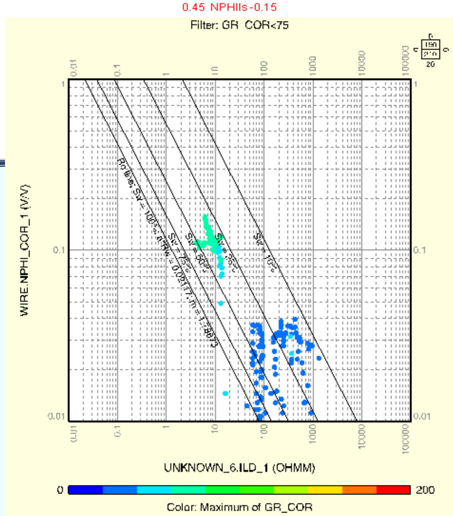
Munich-Fürstenfeldbruck

PART 1

SHORT COURSE PROGRAM







PLANNING OIL AND GEOTHERMAL EXPLORATION PROJECTS: TECHNOLOGIES OF THE PETROLEUM INDUSTRY

SHORT PROGRAM INDEX

THE STUDIES
THE MACRO-FIELD
REGIONAL STUDIES
GEOPHYSICAL PROSPECTING
SEISMIC EXPLORATION
AQUISITION
ANALYSIS:
- PROCESSING
- INVERSION
- INTERPRETATION

PETROPHYSICS
THE MICRO FIELD
PHYSICS OF THE TOOLS AND MEASUREMENTS
LOG-INTERPRETATION
UPSCALING
RESERVOIR ANALYSIS
INTEGRATED STUDIES
RESERVOIR CHARACTERISATION
STATIC SIMULATION
DYNAMIC SIMULATION
TARGET DEFINITION

OPERATIVE PHASE

THE PLANNING PHASE
DRILLING PROJECT PLANNING
DIRECTIONAL PLANNING
THE DRILLING RIG
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PHYSICAL UNITS AND CONVERSIONS IN THE OIL INDUSTRY
DIRECTIONAL DRILLING METHODS
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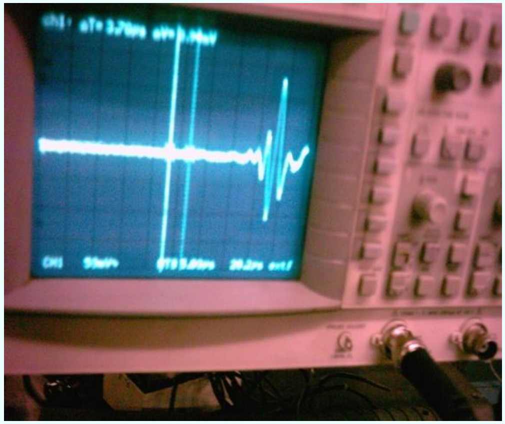
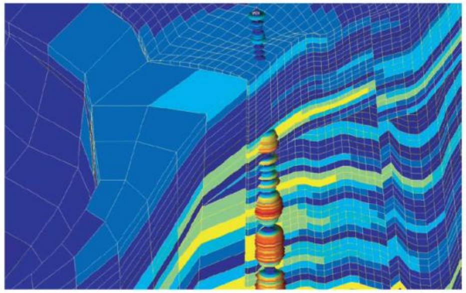
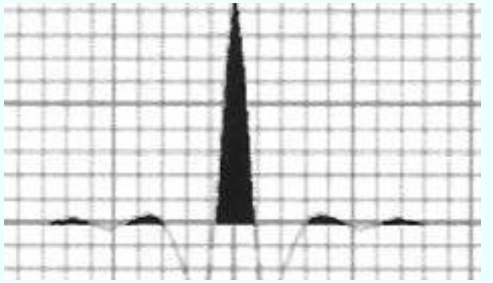
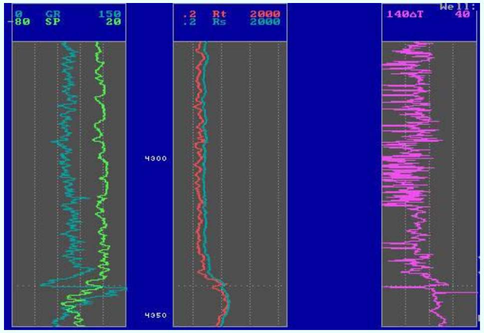
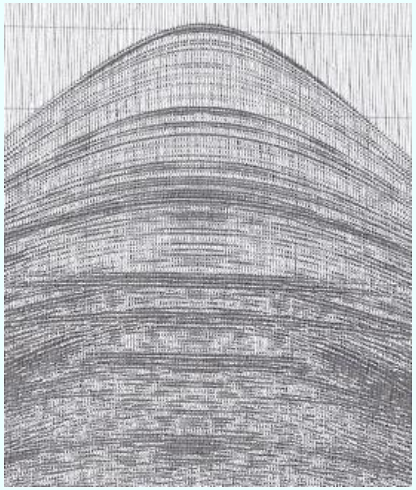
WIRELINE LOGS
REALTIME LOGS AND ANALYSIS
REALTIME RESERVOIR CHARACTERIZATION
TESTING AND PRODUCTION METHODS
STIMULATION: FRAC OPERATIONS, COILED TUBING, ACIDIZING, CO2
WELLTEST

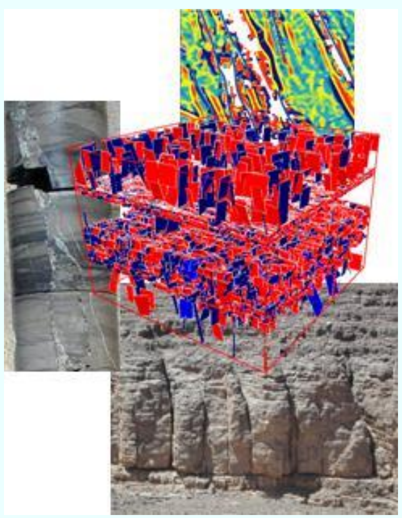












-REGIONAL STUDIES

The reservoir concept: Oil, Gas,Unconventionals, Geothermy
Geology and Plays
Geophysical studies:
Gravitational, Magnetotelluric, Seismic.

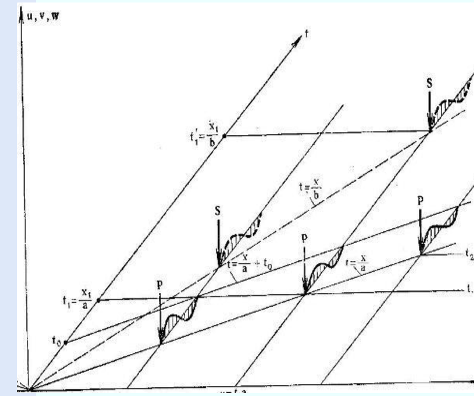
-3D SEISMIC GENERAL CONCEPTS

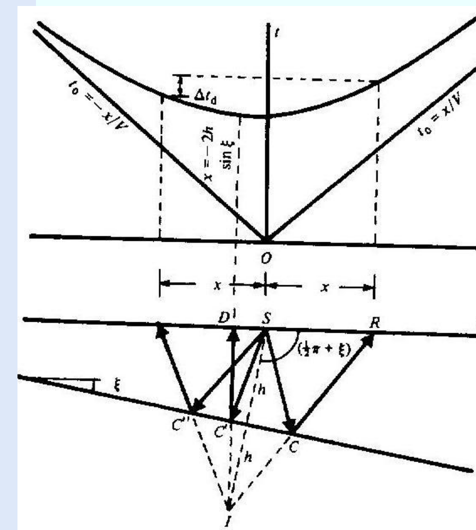
Seismic waves derivation of the wave equation from elasticity theory.
The hooke´s law.
Elastic constants.
The wave equation.
Static versus dynamic elastic parameters.
Geomechanical applications in case studies.

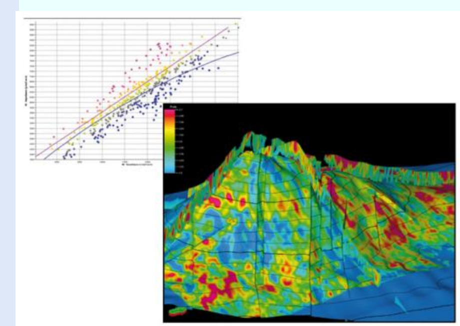
-P-S WAVE PROPAGATION PARAMETERS AND SIGNAL ANALYSIS CONCEPTS

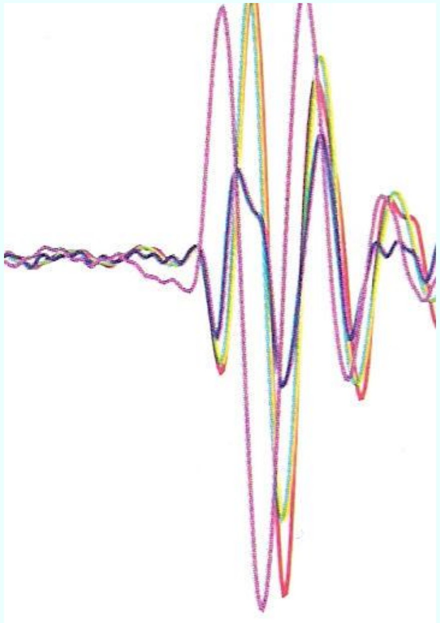
Parameters: amplitude, phase, angular frequency, wavenumber, initial phase,
Frequency,period,wavelength,velocity of propagation.
Monochromatic waves and Fourier series.
The complex notations for wave equations.
Energy of a wave, intensity, spherical divergence.
Group and phase velocity, diffraction, reflectivity and trasmissivity.
The zoeppritz equations (zero offset), acoustic impedance.
Reflection and transmission coefficients.

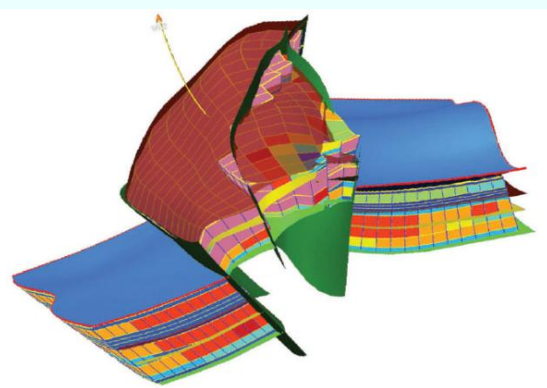
PROCESSING CONCEPTS: AMPLITUDE AND PHASE CONSIDERATIONS
Effects of amplitude, frequency and phase shifts.
Amplitude and phase spectra.
Log simulation through 1-D Fourier transform.
Wave vector representation.
Fourier Transform pairs.
Frequency aliasing.
Seismic reflection models.
Impulse respons models.
Reflection shapes, signatures, spike synthesis.
Time and phase shifts.
Convolution, crosscorrelation, autocorrelations algorithms, schematic of calculation methods.
The "alternative" Fourier transform.
Frequency domain operations, time and frequency domain conversions.
Seismic impedance, reflection/transmission coefficients and seismogram.
Sonic logs and synthetic seismograms.

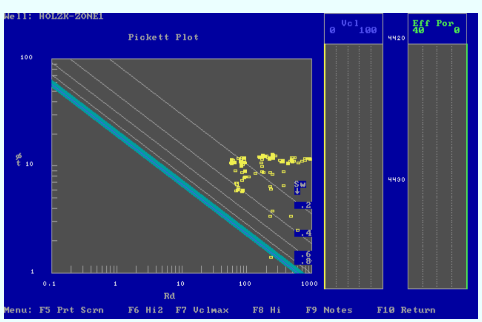












STACKING OF SIGNALS, CDP STACKING
Vector representation of signal and random noise.
The stacking process as a vector sum.
Effect of noise bursts and random noise addition.

APPENDIX
Deconvolution.
Convolutional model in time domain.
Convolutional model in frequency domain.
Inverse filtering.
The source wavelet inverse.
Least square inverse filtering.
Minimum phase wavelet.
Wiener filters.
Spiking deconvolution.
Prewhitening.
Wavelet processing and shaping filters.
Predictive deconvolution.

-SOURCE MODELS

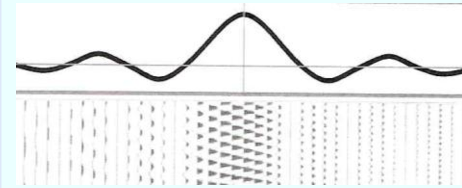
The Dirac Delta function.
Impulse time shift, shifting properties.
Approximations of the Delta function: Rect, Triangular, Gaussian, Cauchy-Lorentz, Cauchy phi, sinc, sinc square.
The Heaviside unit step function.
Time shift. Effects of phase spectrum on wavelet shape.

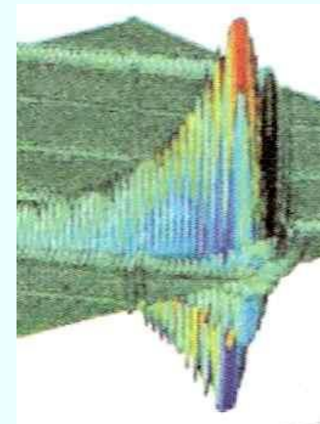
-VIBROSEIS AND SWEEP THEORY

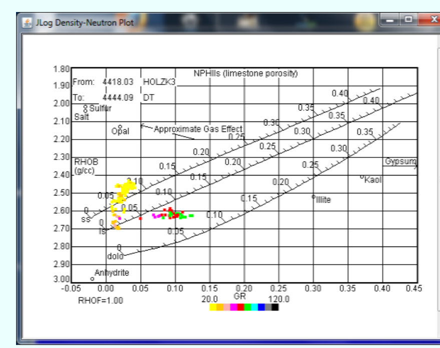
Sweeps crosscorrelation and autocorrelation.
Sweep design.
Bandwidth, frequency and taper.
Side lobes and noise.
Vibrator harmonic ghosts.

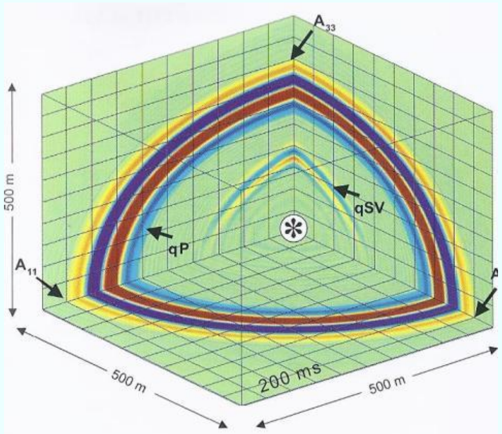
-ARRAY DESIGN

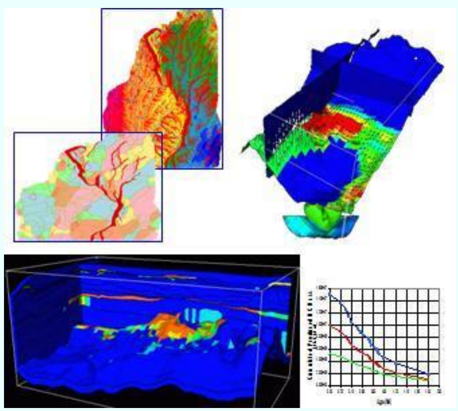
Coherent and incoherent noise.
Synthetic record analysis.
Dominant frequency.
The uniform array, Array linear responses and "alias peaks" as f,k,d and lambda functions.
Shallow and deeper reflectors and frequency content.









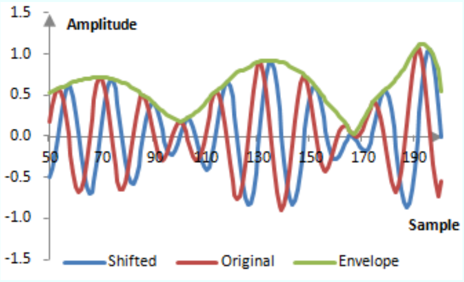


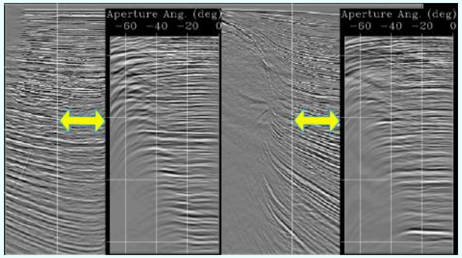
-3D SEISMIC FIELD ACQUISITION PLANNING

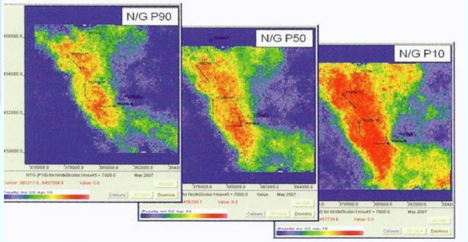
Terminology and definitions in 3D seismic design:
Box, CMP bin, super-bin, inline, crossline, fold, fold taper, mid-point, migration apron, patch, receiver line, source line, scattering angle, S/N ratio, source point density, swath, template, aspect ratio, svy geometry, Xnim, Xmax.
Gather types: orthogonal, common source point, common receiver, common offset, common azimuth, cross-spread, offset vector tile.

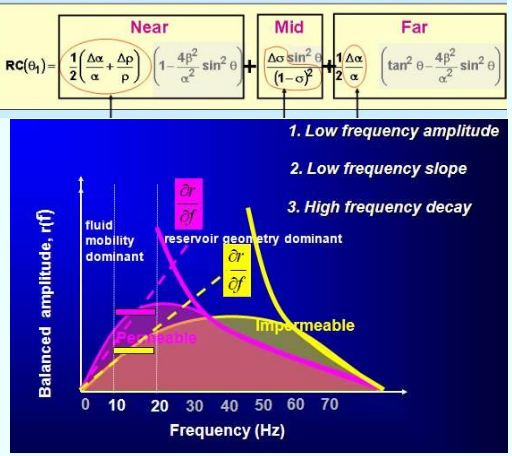
3D SURVEY GEOMETRY PLANNING:
Fold vs S/N ratio, 3D vs 2D fold, inline and xline fold, tot. fold.

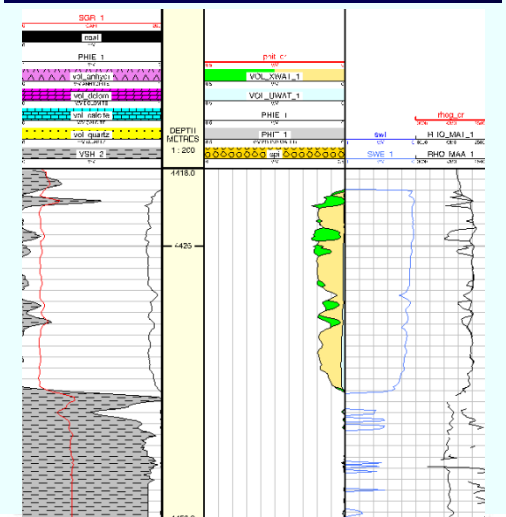
QC: fold taper, S/N ratio and target size.
Unaliased frequency.
Offset and azimuth distribution.
Wide and narrow azimuth.
Fresnel zone.
Migration apron.
Field layouts.
The 5D prestack field.
Main guidelines for 3D seismic field acquisition planning.











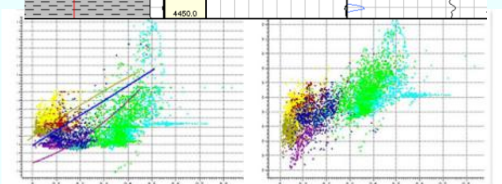


TABLE 4.1—EQUATIONS FOR FRACTURE LENGTH, MAXIMUM FRACTURE WIDTH, AND INJECTION PRESSURE FOR CONSTANT INJECTION RATE

	$L(t)$	$w(0,t)$	$p(0,t)-\sigma_H$
PKN Model	$C_1\left[\frac{Gq_0^3}{(1-\nu)\mu h_f^4}\right]^{1/5} t^{4/5}$	$C_2\left[\frac{(1-\nu)q_0^2\mu}{Gh_f}\right]^{1/5} t^{1/5}$	$\frac{C_3}{H_f}\left[\frac{Gq_0^3\mu L}{(1-\nu)^3}\right]^{1/4}$
GdK Model	$C_4\left[\frac{Gq_0^3}{(1-\nu)\mu h_f^3}\right]^{1/6} t^{2/3}$	$C_5\left[\frac{(1-\nu)q_0^3\mu}{Gh_f^3}\right]^{1/6} t^{1/3}$	$\frac{C_6}{2H_f}\left[\frac{Gq_0\mu h_f^3}{(1-\nu)^3 L^2}\right]^{1/4}$

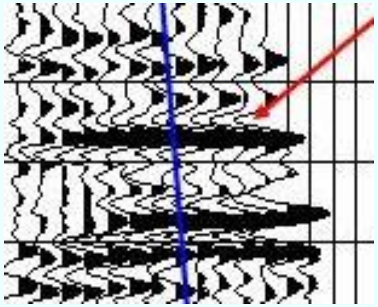
Observe that p_0 increases with fracture length and thus treatment time for PKN models and decreases with fracture length for GdK-type models.

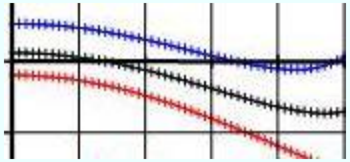
-SEISMIC PROCESSING

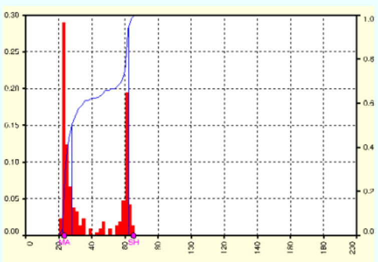
PREPROCESSING:
SEG-Y Format Structure.
Processing sequences overview .

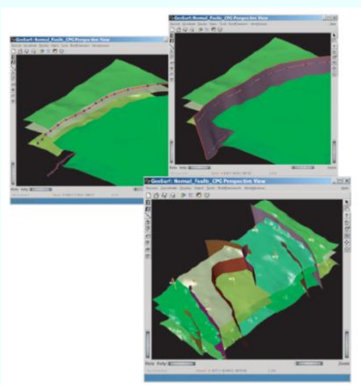
Gain recovery (agc).
Multiplexing and demultiplexing.
Resampling.
Passband filters.
Assign geometry.
Statics and datum correction.
Deconvolution.
Spherical divergence correction.
Trace editing.
NMO stretch.
Display of brute stack.
Velocity analysis.
Surface consistent statics.
Intermediate stacks.
Final velocity analysis.
3D trim statics.
fx-deconvolution.

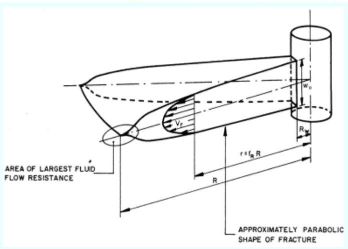
THE 2D-FOURIER TRANSFORM
Spatial aliasing.
Monofrequency signals in the f-k domain.
f-k spectra.
Antialias filters.











-SEISMIC PROCESSING

MIGRATION

Vertical velocity change, ray tracing, diffraction models, DMO migration and dip calculation, zero offset migration of linear reflectors and compass migration, dips before and after migration, offset modeling with variable source/receiver offset, exploding reflectors model, Huygens model, the diffraction model from Huygens to Kirchhoff, downward continuation, post-stack migration methods, Kirchhoff migration, relationship between hyperbola and horizontal reflector , depth and time equations, Kirchhoff migration algorithm, aperture, time interpolation, pre-stack migration, the semi-ellipse as reflection point loci.
Geometry of dip dependent moveout : DD-MO, diffraction modelling of source gathers, scatterpoints and diffractions of constant offset sections, zero offset and constant offset examples, principles of dip-moveout corrections, prestack migration of 3D data volumes, non-zero offset traveltime, DMO, depth migration, kirchhoff depth migration.

APPENDIX

Tau-p transform and gaussian beam.
Reverse time migration.
3D Kirchhoff surfaces.
Kirchhoff summation surfaces Z-O.
Traveltime surface in constant V Z-O.
Field and mid-point offset coordinates
VTI, TTI, time migration examples.
Effects of migration aperture.

-SEISMIC PROCESSING: VELOCITIES

Instantaneous, average, RMS, stacking, interval, migration, and DMO velocities: fields of applications.
Instantaneous velocity (Vins), Average velocity (Vave), RMS velocity (Vrms), Stacking velocities (Vstk), Interval velocities (Vint).
Errors in interval velocities calculated from stacking velocities.
The RMS applications.
The Eikonal equation: finite grid element traveltime computation.
The wave equation.
Modeling the wave equation in finite grid elements.
Derivatives of the equation.
Solutions of the full wave equation and finite grid elements solutions.

DISCUSSION ON SEISMIC VELOCITY ANALYSIS
NMO for flat reflectors.
Horizontal reflectors series NMO.
Moveout equations of fourth an n order.
NMO stretch.
Dipping reflectors influence on moveout velocity.
Effect of inclination and velocity on NMO for a stratigrafic sequence.
Velocity analysis: traveltime, best-fit and small-spread hyperbolas.
T-X velocity analysis of synthetic gathers.
T-X velocity analysis of CMP gathers.
Velocity spectra.
Coherence Algorithms: stacked amplitude, normalized stacked amplitude NS, time gate normalized and unnormalized xcorrelation sum (N CC), (U CC), energy (E CC), semblance (N E).
Velocity sensitivity to seismic parameters.
V spectra: gate row and contour plots.
Spectra: mute compensation and stacking effects.
Interactive velocity analysis, horizon velocity analysis, coherency attributes stack.

-SIGNAL ANALYSIS IN PROCESSING OPERATIONS

Wavelet signatures.
The Fourier transform expressions in the seismic theory notations.
The Convolution theorem.
Nyquist frequency: sampling and aliasing operations: Comb, Sync, Boxcar.
Laplace transform and Z-Transform.
Transfer functions.
Applications of correlation and autocorrelation functions to discrete time systems.
Cohrence and semblance functions.

-ROCK PHYSICS AND AMPLITUDE INTERPRETATION

The effective model – from micro to macro-elastic field.
The rev: "representative elementary volume".
Effective medium modeling.
Elementary and effective medium elastic parameters calculations: k, mu, rho.
Effective models: Gassmann, Hertz-Mindlin, Voigt, Reuss, Hill, Hashin-Shtrickman.
Upgrade to the macro-field theory.
The Aki-Richards AVO equations.
Zoeppritz equations linear approximations: Wiggens, Shuey, Borthfeld.
Intercept and gradient parameters.
P-S Velocity, Poisson ratio, density dependency.

Upgrade to the macro-field theory: near, mid and far offset range stack.
Shuey and Hilterman theory.
Rock physics properties influence on angle stacks.
Normal incidence and Poisson reflectivity.
Review of elastic parameters and their effective medium composition in the AVO equations context.
Effective medium averaging equations.
Gamma/Poisson relations.

V and density interpretation.
V-density transforms.
Alternative equations for normal incidence reflection coefficient (NI-RC).
NI-RC: V and Rho sensitivity.
Thin bed analysis.

AVO classifications.
AVO class reconaissance on angle stacks.
Predicting hydrocarbon response in Poisson - RC xplots.

Abnormal pore pressure from seismic data.
Hydrostatic, overburden, effective P.

-AVO ANALYSIS AND SEISMIC INVERSION

Aki-Richards, Wiggins and Fatti forms of Zoeppritz equations linearizations.
The 2 and 3 term Aki-Richards equations.
Significance of intercept, gradient and curvature.
Offset to angle conversions.
AVO seismic attributes and composite attributes and interpretation methods.
Poisson ratio change, shear reflectivity and fluid factor, Rp and Rs.
Castagna mud-rock line.
Rutherford AVO classification.
NI-G xplot and AVO classes.

AVO/AVAZ VTI and HTI weak anisotropy.
Thomsen parameters.
The Aki-Richard equation as a function of Thomsen parameters.
Ruger VTI and HTI equations.
Polarization analysis and anisotropy static modeling.

3D SEISMIC INVERSION
Post-stack and pre-stack seismic inversion.
Elastic inversion.
Acoustic impedance, elastic impedance, extended elastic impedance.
Independent AVO inversion.
Simultaneous AVO inversion.
LMR.

PROCESSING ISSUES
Random and coherent noise attenuation.
Super-gather, parabolic radon transform, RNMO and higher oreder moveout.
Time variant trim statics.

SEISMIC ATTRIBUTES AND 3D VOLUME PROPERTIES DISTRIBUTIONS
Multiattibutes analysis.
Amplitude, complex, time attributes:
Hilbert tansform, real and complex amplitude components.
Amplitude Envelope.
Instantaneous Phase.
Instantaneous Frequency.
Average Frequency.
Dominant Frequency.
Derivative.
Derivative Instantaneous Amplitude.
Second Derivative.
Second Derivative Instantaneous Amplitude.
Amplitude Weighted Cosine Phase.
Amplitude Weighted Frequency.
Amplitude Weighted Phase.
Cosine Instantaneous Phase.
Apparent Polarity.
Integrate.
Integrated Absolute Amplitude.

Predicting target properties in multiattribute space.
Decreasing the prediction error.
Crossvalidation.

Neural networks modeling: from linear to non linear prediction.
Nodes in hidden layers, total iterations.

Stochastic inversion.

-GEOSTATISTICS

From stochastic inversion to geostatistics.

REV (representative elementary volume) and scale variability.
Statistical parameters (univariate distribution).
Sample declustering with elementary statistical parameters.
Moving window statistics.
Bivariate statistics.
Linear regression.
Bivariate statistics for spatial data.
Probability.
Mathematical expectation.
Statistics algebra.
The normal (gaussian) distribution.
Lognormal distribution.
Distribution of static and dynamic reservoir properties.
Stationarity.
The variogram.
Lag tolerance.
Variogram modeling: Nugget, spherical, exponential, gaussian and combination models.
Geometric anisotropy.
Crossvariogram.
Conventional estimation and Kriging: simple and ordinary Kriging.
Cokriging, multigaussian Kriging.
Grid based simulation: sequential gaussian simulation (SGS).
Estimation at the unsampled location.
Comparisons: Kriging and SGS.
Multiple realizations.

-SEISMIC ATTRIBUTES ANALYSIS

Attributes classifications: amplitude attributes, complex attributes, time attributes.
Spectral decomposition.
COMPLEX ATTRIBUTES.
Hilbert transform motivation: the causality condition.
Hilbert transform as convolution operator.
Real and Imaginary components.
Instantaneous phase and frequency.
Envelope and Signal strength.
Zero crossing effect.
Complex attributes interpretation.
Tapered window and Morley wavelets.
SPECTRAL BALANCING AND SPECTRAL DECOMPOSITION.
Colored spectrum.
Spectral decomposition and interpretation´s workflow.
Tuning frequency and sensitivity of spectral components to formation thickness.
Multiattributes interpretation in the frequency domain.
Statistical discrimination on spectral components.
Sensitivity of spectral components to hydrocarbons.
Diffusive Q-model: fluid mobility attributes.
Singularity attributes.
Instantaneous frequency as reflector continuity indicator.
SPICE algorithm and waveform singularities as coherence attributes complement.

-SEISMIC ATTRIBUTES ANALYSIS

GEOMETRIC ATTRIBUTES.
Complex trace analysis: calculation of vector dip and azimuth.
Gradient structure tensor to calculate vector dip.
Discrete search estimate of coherence to calculate vector dip.
Estimate of coherence, dip and azimuth.
Various methods of coherence calculation.
Coherence in the analytic trace and zero crossing issues.
CURVATURE ANALYSIS AND REFLECTOR SHAPE.
Sobel edge detector.
Curvature and structural interpretation.
GLCM textural attributes: energy, entropy, contract, homogeneity.
Visualization of geometric attributes.
Facies analysis.
Multiattributes analysis and color codes visualization.
Multiattributes analysis with overlays and animation.

-GENERAL PETROPHYSICS

The invasion process.
Archie law, formations parameters.
Resisitivity logs.
Resistivity devices:
Focusing electrode logs, microresistivity devices, Induction logs.
Log interpretation.
Formation water resistivity determination.
Determination of saturation.
Rwa as hydrocarbon indicator and overlay solution.
NGS log, porosity logs, density and lithodensity logs, neutron logs.
Lithology and porosity determination.
Formation microscanner and FMI.

-PETROPHYSICS OF CLASTIC FORMATIONS

Formation factor and resistivity index.
Cementation exponent calculation in the Archie equation.
Sw equations and porosity-conductivity partitioning.
Sw calculation in non-Archie formations.
Porosity and saturation partitioning.
Physics of petrophysics parameters measurements.
Equivalent circuits for induction and laterolog tools.
Density and photoelectric cross section measurements.
Pulsed neutron log.
Nuclear magnetic resonance tool theory.
Surface, bulk and diffusion relaxation.
T2 spectrum and cutoffs.
FFI, BWF, BVW typing.
Kozeny-Kenyon and Timur-Coates permeability.
Pc curve and NMR log links.
Dipole-Dipole sonic applications. STC processing.
K and Stoneley waves.
Shear waves anisotropy: fast ans slow S-waves.
V-Phi transforms.
Secondary porosity index.
Gas detection. Xplots DT-Vp/Vs.
Shear waves polarization and splitting: structural and geomechanical interpretation.
Sonic and FMI correlations.

P-S slowness and elastic parameters.
Log tools resolution and ray of investigation.
Log interpretation methodes: Deterministic and stochastik.
Xplots: NPHI-RHOB, DT-RHOB, M-N, Rhoma-Uma, Rwa-Gamma.
Shale typing on xplots, shale and gas corrections.
Pickett plot.
Buckle plot: BVW, Pcap, Swirr, Flow units, Permeability.
BVW and hydrocarbon interpretation.
m-PHI and porosity characterization.

-PETROPHYSICS OF CARBONATE FORMATIONS

The Lucia classification.
Wellbore proximity sectors on carbonate formations.
Vp-Porosity and parameters controlling Vp.
NMR and porosity partitioning.
Pc curves in the context of Lucia carbonate classification.
Winland R35 in the context of Lucia carbonate classification.
Swirr and flow units in the context of Lucia carbonate classification.
Pc curve, NMR, R35, Ka-PHI: reservoir system quality and performance.
Petrofacies and NMR T2 distribution.
Vuggy porosity.
m structural parametrization: VPR and Brie model.
Porosity partitioning in the m dual porosity equation.
The modified Myers model.
m and porosity type.
n exponent, wettability and NMR porosity typing.

PICKETT PLOT INTERPRETATION.
Effects of petrophysical parameters on the Pickett plot:
Sw, m, Rw, n, BVW,Tau, K.
Buckle/Pickett parallel effects: BVW,Sw,K,m.

-STATIC SIMULATION

Between seismic inversion and dynamic simulation.
The 3D SEGY seismic cube.
Operations on the 3D seismic cube.
Positioning petrophysics, drilling dynamics and core data on the 3D cube.
Seismic data visualization: Slices, inlines , crosslines, randomlines, timeslices.
Synthetic seismogram calculation.
Horizon and fault interpretation (autotracking, anttracking), mapping.
Attributes cube generation, attributes map generation.
Volume rendering.
Volume extraction.
Seismic petrophysics attributes.
The Static model.
Logs loading and correlation.
Fault interpretaion and digitization: fault sticks, polygons, digitizing modes.
Pillar gridding: create skeleton grid and horizons building.
Time to depth conversion.
Inter-horizon Zones (isocrones).
Inter-zone Layering (facies / flow units / strata).
Geometrical property modeling.
Upscaling of petrophisical properties.
Facies modeling: sequential indicator simulation.
Object modeling.
Petrophysical modeling: petrophysical properties spatial distribution.
Deterministic workflow (Kriging), stochastic workflow (Sequential Gaussian Simulation).
Volume and STOIIP calculation.
Well trajectory design.

PART 2

3D SEISMIC MULTICOMPONENT.
FROM PRINCIPLES TO MULTICOMPONENT AND JOINT SEISMIC INVERSION

By Robert J. Garotta

Section 1 Historical overview, 3D-1C Seismic methods

Section 2 Why use shear waves

- When compressional mode fails .
- When lithological information is required .
- When fluid contend is important.
- When confirmation is needed.
- When shallow to medium depth resolution is required.

Section 3 Theoretical basis

- Elastic wave propagation in homogeneous media.
- Reflection, transmission and conversion of elastic waves.
- Boundary and surface waves.
- Wave attenuation.
- Modelling.

Section 4   Multi-component seismic acquisition

- Shear wave sources.
- Land multi-component receivers.
- Shear wave land acquisition.
- PS mode land acquisition specifics.
- PS mode marine and shallow water acquisition.

Section 5   Processing of multi-component data

- Generalities about Shear mode processing in VTI environment.
- Static corrections.
- Normal moveout corrections.
- Correlation of P and S data.
- Generalities about PSv mode processing in VTI environment.
- Processing sequence of PSv mode in VTI environment.
- Particulars of marine processing.
- S and PSV mode processing in an orthorhombic environment.
- Inversion and azimuthal analysis.

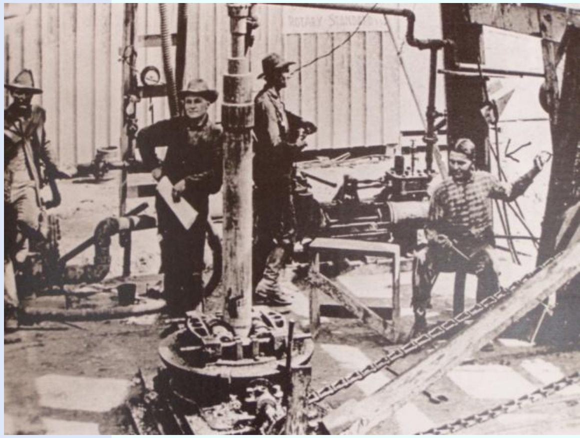
Section 6 Results of multi-component surveys

Conclusions

PART 3

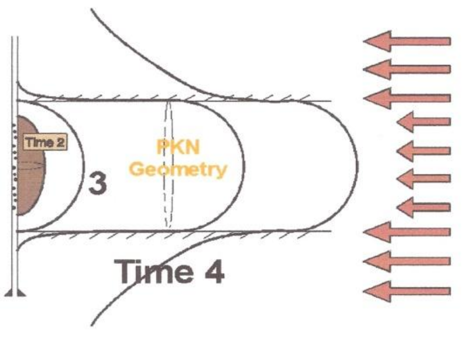
-DRILLING TECHNOLOGY

Main components of a drilling rig.
Data Logging.
Drilling optimization programs.
Drilling methods.
Completions.
Onshore and offshore rigs.



-D&I MEASUREMENTS
AND DIRECTIONAL DRILLING

The earth magnetic field.
Magnetic field components: azimuth, dip, declination.
Directional surveys.
Accelerometers, magnetometers, gyroscopes.
Non-magnetic collar calculations.
Declination and grid corrections.
Gravity and magnetic tool/face.
Survey parameters: svy station, inclination, azimuth, departure, course length, hole direction,
TVD, MD, closure, vertical section, closure direction, course deviation, target.
Tangential method calculation for well trajectory.
Minimum curvature method calculation for well trajectory.
Target definition.

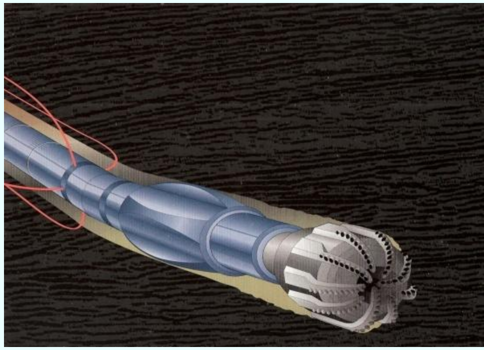


-HYDRAULIC FRACTURING OPERATIONS

In-situ stressfield (closure).
Stress Origin and Magnitude.
Pore Pressure effect.
Elasticity and stress-parameters.
Faulting theory.
Fracture-Azimuth.
Fracture-Geometry.
Hydro-Frac Operations Planning.
Main Variables and Units.
Units Conversions.
Perkins&Kern Model.
Nolte Analysis.
Efficiency.
Tests.

-WELL TEST ANALYSIS

Short overview of modern Well Testing and Curves Interpretation.



PROPEDEUTICAL MATERIAL AVAILABLE AS PDF FILE

-CALCULUS AND LINEAR ALGEBRA
-MATRIX AND TENSORS
-FROM FOURIER TO HILBERT
-STRUCTURAL PLAYS
-INTRODUCTORY ELEMENTS OF PETROPHYSICS
-INTRODUCTORY ELEMENTS OF SEISMOLOGY

PART 4

INTERPRETATION WITH PROFESSIONAL SOFTWARE
(This chapter will vary from session to session, the participant will be informed upon registration)

SEISMIC PROCESSING
Construct velocity model, ray tracing, acquisition on earth model, compare with seismic data, examine shot gathers, sort CDP gathers, velocity analysis, NMO correction, stack, migration

SEISMIC INTERPRETATION
Examples will be with Quantitative interpretation and AVO or Attibutes Analysis.
Seismic Attributes:
Data Loading: SEGY, Creation of a Steering Cube, Horizon Cube etc, Well-Tie, Visualization of Horizons Slices, Inline , Xline, Transverse, Horizontal Sections, Autotracking, Anttracking, Attributes Analysis, Volume Rendering, Spectral Decomposition, Properties Crossplotting, Velocity Analysis, Sequence Stratigraphy

LOG INTERPRETATION
Data loading: LAS, DLIS, ASCII, Format Logs, Merge/Shift, SCAL.
Calculation of PHI,Vsh, PHIeff, Frequency Plots, RHOB-NPHI Xplot, Pickett Xplot,Complex Lithology Xplots, Sw, Shy,K, Pay Volume determination. Single Well and Multi-Well Interpretation

STATIC MODELING SOFTWARE (only theoretical introduction) Fault Modeling, Pillar Gridding, Zonation and Layering, Facies Modeling, Petrophysical Modeling, Upscaling, Well Design

DYNAMIC SIMULATION SOFTWARE (only theoretical introduction)
Overview of the Modeling Process, Conceptual Reservoir Scales, Reservoir Structure, Fluid and Rock-Fluid Interaction, Reservoir Simulation, Reservoir Architecture

Course Books:

- J.R. Fanchi - Nontechnical Guide to Petroleum Geology, Exploration,
  Drilling and Production (3rd Edition) by Norman J. Hyne (PennWell, 2012)
-R. Garotta – Multicomponent Seismic (Course Notes)
- GeoNeurale
-Introduction to Geothermal and Petroleum Exploration - Course Notes
- J.R. Fanchi – Applied Reservoir Sinulation
  Gulf Professional Publishing, 2001)
-- A complete reference list of scientific literture papers and books will be set available on the online preparation phase

Instructor’s Biography

Robert Garotta, graduated of the Faculté des Sciences in Paris (DES), began his career at the geophysical department of the French National Centre of Scientific Research (CNRS).
He joined CGG as a field geophysicist, first in the gravity method then as a seismologist.
He was involved in various fields of research and development such as vibroseismic, velocity analysis, static corrections, 3D survey design, shear wave experimentation and processing.
He concluded his career at CGG as Senior Vice President of the CGG Geophysical Methods Department
Robert is still advising the CGGVeritas group in the area of Multi-Component seismic.

Awards:

- Conrad Schlumberger Award from EAGE
- Prix Charles Bihoreau
- SEG Distinguished Instructor
- SEG Honorary Member

Angelo Piasentin, leads since 2007 the scientific course administration at GeoNeurale - Munich.
He graduated in Geosciences with Internato in Geophysics at the University of Padua. He worked with all major oil service companies as a Data Logging Engineer, MWD-LWD Engineer in oil exploration operations in 4 continents in projects for Agip, BEB, BP, Chevron, Ciepsa, Coastal Oil and Gas, Deutsche Texaco, Elf, Enterprise Oil, Ina, Maersk Oil, MND, Mobil, NAM, Norsk Hydro, Pennzoil, Repsol, Shell, Sonatrach, Statoil,Texaco, Vermilion, Wintershall.
He progressed in the Geothermal and Oil Exploration working as a Petrophysicist and Senior Geoscientist (3D Seismic Analysis).
He participated to the course development of Neural Networks Applications for the Petrophysical and Seismic Analysis, Integrated Geostatistical and Petrophysical Applications, Advanced Nuclear Magnetic Resonance Petrophysics, Integrating Geosciences in Petroleum Exploration.
Authored papers, publications and patents for new Geothermal Exploration systems and new methods for integrated Petrophysical Analysis in the Pre-Stack Seismic Inversion.

Arnaud Huck is Chief Geophysicist of dGB. Arnaud has over 10 years' experience in the geosciences industry, including seismic reservoir characterization, AVO modelling and well modelling.
He is responsible for the management of dGB's services-based operations and customized studies worldwide and the training of seismic interpreters on dGB's open source software OpendTect.
Arnaud holds a MSc degree with honours in Geophysics from the School of Engineering Geophysics of Strasbourg.

REGISTRATION FORM

Please fill this form and Fax to +49 89 8969 1117 or Email to Courses@GeoNeurale.com

INTEGRATING GEOSCIENCES in PETROLEUM EXPLORATION

Munich , 03-08 December 2018

(6-days course)

Course Fee: 3850 Euro + VAT 19% (Private companies outside Germany can be exented from VAT TAX . For informations contact: Courses@GeoNeurale.com)

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- Registration deadline : 02 November 2018

Payment and Registration

Tuition fees are due and payable in Euro upon enrollment in the course by bank transfer to the bank account given below unless another payment form is agreed

Unless otherwise indicated, the payment should be received before the date specified in the invoice as payment term to make the enrollment effective.

To register to the course please fill in the registration form and fax or email it along with the confirmation of your bank transfer to:

GeoNeurale

Administration

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81245 Munich

T +49 89 8969 1118

F +49 89 8969 1117

ONLINE REGISTRATION: www.GeoNeurale.com

Please indicate your name and the purpose:

“ INTERATING GEOSCIENCES in PETROLEUM EXPLORATION “ course fees .

Provisions

Tuition fees are due and payable in Euro upon enrollment in the course. Unless otherwise indicated, fees do not include student travel costs and living expenses.

Payments are also accepted via personal or company check, traveler's check, credit card, and Company Purchase Orders.

Cancellations by Participant:

All cancellation are subject to a 100 Euro non-refundable cancellation fee.

Cancellation have to be notified to our office, at least 30 days prior to the course start date to receive a refund (less the 100 Euro cancellation fee).

If the participants are unable to cancel prior to the 31 days notification date, they may substitute another person at their place in a course by notifying us prior to the course start date.

Course Cancellations:

GeoNeurale reserves the right to cancel the courses if necessary. The decision to cancel a course is made at least two weeks prior to the course start date. If a course is cancelled, the participant will receive a full reimbursement of the tuition fees (but not of the plane ticket or hotel expenses or any other costs), or will be enrolled in another course upon his decision (the cost of the original course will be applied to the cost of the replacement course).

GeoNeurale can not be responsible for any penalties incurred for cancellation or change of airline or hotel reservations .

Refunds: GeoNeurale will promptly remit all refunds of tuition fees due to cancellations or annullment (less any appropriate non-refundable cancellation fee) within 30 days of the course cancellation.

Force Majeure: GeoNeurale can not be responsible for cancellations due to “force majeure” events : strikes, emergency situations, natural catastrophes and all situations and incidents independent or outside the human control that can delay or cancel the course. In case of such events related cancellations the course tuition fees will be refunded to the client .

Geoneurale is not responsible for any delay or absence caused by the training instructor or training instructor company for reasons which are independent or out of the control of GeoNeurale´s decisions.

Upon registration the course participant assumes full responsibility to keep all course material confidential and not to transfer it to any third party.

AGREEMENT: Upon enrollment all parts accept the above mentioned provisions. The above specified provisions shall regulate the agreement between GeoNeurale and the participant and the participant company and will enter into force upon enrollment.

Training location

Conference Center - Forum Fürstenfeld
Room S1 , S5

Fürstenfeld 12
82256 Fürstenfeldbruck - München
Germany

INFORMATIONS, HOTELS, MAPS, LINKS

TRAINING LOCATION – RESEARCH CENTER

http://www.geoneurale.com/documents/GATE-Y7.pdf

GATE GARCHING

http://www.geoneurale.com/documents/GATE-Y6.pdf

MAP MUNICH-GARCHING

http://www.muenchen.city-map.de/city/db/130208000001/14269/Garching.html

MUNICH INFO and MAP MUNICH CENTRAL

http://www.muenchen.de/home/60093/Homepage.html

MAP MUNICH UNDERGROUND

http://www.mvv-muenchen.de/web4archiv/objects/download/3/netz1207englisch.pdf

HOTELS NEAR GeoNeurale

http://www.geoneurale.com/documents/HOTELS-GARCHING.pdf

BAVARIA INFO

http://www.geoneurale.com/documents/Around-Munich-Info.pdf