PETROLEUM AND GEOTHERMAL EXPLORATION: INTEGRATING GEOSCIENCES

A detailed overview on the main disciplines involved in the oil&gas and geothermal exploration. A training on multidisciplinary communication for professionals of the oil and geothermal industry.

R. Garotta, A. Piasentin, A. Huck

GeoNeurale – Munich
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9-15 March 2015 (7-days non-stop course)
GeoNeurale – Munich

7 DAYS COURSE
INSTRUCTORS: Robert Garotta, Angelo Piasentin, Arnaud Huck

A N INTERDISCIPLINARY COURSE FOR EXPLORATION AND PRODUCTION PROFESSIONALS

AUDIENCE: Project Managers, Geophysicists, Petrophysicists, Geologists, Reservoir Engineers

LEVEL: Intermediate to Advanced

PROPEDEUTICAL:
Online course preparation is offered 2 weeks before course start

ONLINE REGISTRATION: www.GeoNeurale.com
Registration deadline: 13 February 2015
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
gate GeoNeurale Training Center

at the Munich-Garching Research Center
PART 1
SHORT COURSE PROGRAM

PLANNING A GEOTHERMAL EXPLORATION PROJECT AND 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
DATA LOGGING AND DRILLING DYNAMICS
PHYSICAL UNITS AND CONVERSIONS IN THE OIL INDUSTRY
DIRECTIONAL DRILLING METHODS
MWD/LWD SYSTEMS
WIRELINE LOGS
REALTIME LOGS AND ANALYSIS
REALTIME RESERVOIR CHARACTERIZATION
TESTING AND PRODUCTION METHODS
STIMULATION: FRAC OPERATIONS, COILED TUBING, ACIDIZING, CO2 WELLTEST

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STIMULATION: FRAC OPERATIONS, COILED TUBING, ACIDIZING, CO2 WELLTEST
DETAILED PROGRAM
REGIONAL STUDY
The reservoir concept: Oil, Gas, Unconventionals, Geothermy
Geology and Plays
Geophysical studies:
Gravitational, Magnetotelluric, Seismic

3D SEISMIC EXPLORATION
GENERAL CONCEPTS
SEISMIC WAVES
The Wave Equation
MAIN ELASTICITY PARAMETERS
Young, Poisson, Rigidity, Bulk Modulus, Lame constants (Static and Dynamic domains)
P-S WAVES PROPAGATION PARAMETERS

IMPORTANT LAWS FOR WAVE PROPAGATION:
Snell, Huygens, Zoeppritz

WAVE PROPAGATION MODELS
Ray Tracing, Diffraction Modeling, Exploding Reflectors, Huygens Model, Kirchhoff,
Wave Equation, Eikonal Equation

GEOMETRY OF SEISMIC WAVES PATH – RAY PROPAGATION
GEOMETRY / PHENOMENA
NMO, DMO, Offset, Velocity, Raypath, Reflection, Refraction, Transmission, Conversion, Polarization, S-Waves Splitting
Diffraction, Multiples, Sideswipes, Dispersion, Anisotropy

VERTICAL AND HORIZONTAL RESOLUTION
Tuning Thickness, Fresnel Zone

SOURCE MODELS
The Dirac Impulse, Zero and Minimum Phase Wavelet, Sweep, Sweep Design (Bandwidth, Frequency, Taper)
THE UPCOMING SEISMIC EVENTS
Event Signatures, Basic Wavelets, Integral, First and Second Derivatives, Polarity

SOURCES
Vibroseis, Explosives, Waterguns

RECORDERS
Geophones, Geophones Arrays, Marine Streamers

3D SEISMIC PLANNING
3D Seismic Layout Parameters:
Main Concepts: (Inline, Crossline, CMP, Bin, Fold, Taper, Patch, Scattering angle, Template, Xmax, Xmin, Migr-Apron, S/N Ratio)

ELEMENTARY SEISMIC DATA PROCESSING ISSUES
Geometry, Amplitude recovery, Deconvolution, Statics, Noise attenuation, Velocities, Stacking, Migration, Inversion

PROCESSING SEQUENCE (a turnkey price example)
Demultiplex and edit field data
Gain recovery
Resampling and passband filters
Instrument and geophone dephasing
Geometry and refraction statics analysis
Deconvolution and filter tests
Spherical divergence and amplitude corrections
Trace editing
Surface-consistent deconvolution and scaling
Brute stack
Velocity analysis
Automatic surface consistent statics
Intermediate stacks
Final velocity analysis
3-D trim stack with final statics
FX-decon
3-D migration after stack, one-pass

Further unit price options and SEGY format deliverables
GENERAL CONCEPTS IN THE PROCESSING WORKFLOW

- ELEMENTS OF DIGITAL ANALYSIS OF ANALOG SEISMIC SIGNALS
  The Raw Signal, Ricker Wavelet and Spectrum, Zero Phase and Minimum Phase, Fourier transform, Frequency and Phase Spectra, the Sampling Theorem, Aliasing, Nyquist Frequency, the Convolution Theorem, Comb, Sinc, Boxcar, Hilbert transform, Z Transform, Laplace Transform and Transfer Functions, Convolution/Deconvolution, Filters, S/N Ratio, Autocorrelation, Crosscorrelation, Coherence, Semblance, Function Shift/Spectral Changes, Spectral Shift/Function Changes

THE ANISOTROPY PROBLEM
  Micro and Macro Anisotropy, Anisotropy Systems, the Stiffness Tensor, Parametrization of Anisotropy, Polarization, qP and qS Waves. Weak Anisotropy. The Thomsen Parameters. VTI and HTI media. AVAZ.

THE VELOCITY MODEL
  V-Analysis, Vrms, Vinterval, Vstack, Dix Equations, Dispersion and Frequency dependency

IMAGING
  Pre and Post-Stack Migration
  NMO, DMO, Zero Offset, Ray Tracing, Diffraction Modeling, Fourier, Exploding Reflectors, Huygens, Wave equation, Eikonal equation, Kirchhoff Migration, Tomography, Beam Migration, RTM, WEM

INVERSION
  Pre and Post-Stack Inversion.
  Linearization of the Zoeppritz Equation. The Aki-Richards Equation. Elastic Impedance, LMR, Simultaneous Inversion. Convolutional Model, Recursive Inversion, Colored Inversion, Sparse Spike Inversion. Stochastic Inversion...
  Concepts of Space-Statistics, Heterogeneity, Anisotropy, Variographic Functions and Structure (Lag, Nugget, Range, Sill), Variogram Models, Covariant and Fractal Models, REV (Representative Effective Volume) and Measurements Resolution.

INTERPRETATION
  Amplitude, Signature, Seismic Stratigraphy, Noise, Multiples, Side-Swipes, Diffraction, Seismic Attributes Analysis, Amplitude Interpretation, modern Workstations Interpretation programs Workflows
AVO INTERPRETATION AND ROCK PHYSICS

The Effektive-Volumes: Gassmann, Hertz-Mindlin, Voigt, Reuss, Hill, Hashin-Strickman, CCT, SCA,DEM Models,
Sonic-Sampling In-Field
Seismic-Sampling In-Field
Velocity Models and Anisotropy
Linearized Models of the Zoeppritz Equation, Shuey Equation, Angle-Stacks, Cube-Stacks,
NI and Poisson Reflectivity
Reservoir-Impedance , AVO Classes 1,2,3 , Seismic Signatures, AVO Attributes Analysis

SEISMIC ATTRIBUTES ANALYSIS
Interpretive Processing for Seismic Attributes, Amplitude, Time and Complex Attributes, Spectral Decomposition. Multiattributes Interpretation

CLASTIC AND CARBONATE PETROPHYSICS
The Archie’s Equation and Archies Parameters: (a,m,n,F), Porosity Partitioning, Vsh and Sw Determination, Saraband Model, Dual Water Model, Sw Equations for Shaley-Sands Analysis, Lucia Classification, Porosity /Secondary Porosity classification and m-Dependency, Saturation Zones, Capillary Pressure Curve, Winland / Fock and Munn theories,
The General Parallel Conductor Model, the Dual-Porosity Model , Special Core Analysis

STATIC SIMULATION

SEISMIC AND PETROPHYSICAL RESERVOIR CHARACTERIZATION,
STATIC SIMULATION IMPLEMENTING MODELS
3D Seismic Visualization, 3D Modeling, the Seismic Impedance, Coherence, Steering Cube, Inline/Crossline Sections, the Attributes Cube, Structural Models,
Fault Modeling, Pillar Gridding, Zonation and Layering, Facies Modeling,
Petrophysical Modeling, Upscaling, Variogram Modeling, Kriging Algorithms, Sequential Gaussian Simulation, Multiple Realizations Models, Neural Networks Estimation Models
Electrofacies concepts, Volume Calculation, Target Definition, Well Design

TARGETS
Oil and Gas Targets, Hot Dry Rock , Hydrogeothermal , High Entalpy Targets
PART 2
Seismic 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 content 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
- Drilling tools
- The Drilling Process
- Drilling Monitoring Systems and Sensors

DATA LOGGING PARAMETERS
- ROP, RPM, TORQUE, WOB, HKLD, SPM, T,
- TOTGAS, Gas-Chromatography C1-nC5.
- Lithology Cutting and Core Analysis, Masterlog
- Chemical Analysis

DRILLING OPTIMIZATION PROGRAMS
- Data Processing and Programs
- HYDRO, PORE-PRESSURE, DRILL-OPTIMIZATION,
- MECHANICAL EFFICIENCY PROGRAMS

DRILLING METHODS
- Rotary Drilling and Sliding
- Modern Drilling Methods

COMPLETIONS
- Casing
- Completions
- Formation Damage and Stimulation
- Typical Drilling Problems

SURFACE FACILITIES
- Onshore Facilities
- Offshore Facilities
D&I MEASUREMENTS and DIRECTIONAL DRILLING
- Gravity and Magnetic field
- Non-magnetic-collar calculations
- Survey,
- sensors (accelerometer, magnetometer, gyroscope)
- MWD gravity and magnetic - T/F
- Directional Parameters
- Critical Parameters (direction, dog leg severity)
- Survey Parameters (md, tvd, svy station, inclination, azimuth, up svy station, latitude, departure, course length, course deviation, closure, closure direction, vertical section, target)
- Corrections: magnetic declination / meridian divergence (grid north, true north)
- Directional Planning: calculation models (tangential-method, minimum curvature method)
- target-tolerance

TRANSIENT WELL TESTING
DST, RFT
Short overview of modern Well Testing and Curves Interpretation
PRODUCTION EVALUATION TECHNIQUES
Decline Curve Analysis
Material Balance
Production Performance Ratios and Drive Mechanisms
Tracer Tests

RECOVERY AND RESERVES
Recovery
Reserve Definitions
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
PART 4
INTERPRETATION WITH PROFESSIONAL SOFTWARE

SEISMIC INTERPRETATION
Examples will be with Quantitative interpretation and AVO or Attributes 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, Antracking, 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,
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 Siulation
  Gulf Professional Publishing, 2001)
-- A complete reference list of scientific literature 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. He participated to the course development of Neural Networks Applications for the Petrophysical and Seismic Analysis and Integrated Geostatistical and Petrophysical Applications. 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

INTRODUCTION TO THE PETROLEUM AND GEOTHERMAL EXPLORATION
Munich, 9-15 March 2015

(7 Days non-stop)

Course Fee: 3650 Euro + VAT 19% (Private companies outside Germany can be exented from VAT TAX. For informations contact: Courses@GeoNeurale.com)

Name:
Company:
Address:
Job Title:
Phone:
Fax:
Email:

SIGNATURE: ______________________________
Registration Details

• Course fee: 3650 Euro + VAT (19%) (No VAT applicable for specific countries, please contact us for further informations )
• Registration deadline: 13 February 2015

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
Am Nymphenbad 8
81245 Munich
T +49 89 8969 1118
F +49 89 8969 1117

ONLINE REGISTRATION: www.GeoNeurale.com

Bank Information: Genossenschaftsbank EG Muenchen
Bank Account N. 519618             BIC – Code: GENODEF 1M07
BLZ 701 694 64             IBAN: DE19 7016 9464 0000 5196 18

Please indicate your name and the purpose:

“PETROLEUM AND GEOTHERMAL EXPLORATION: INTERATING GEOSCIENCES “ 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 cancellations are subject to a 100 Euro non-refundable cancellation fee.

Cancellation must 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 cannot 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 cannot 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 – RESEARCH CENTER

GATE GARCHING

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

BAVARIA INFO