

# GeoNeurale

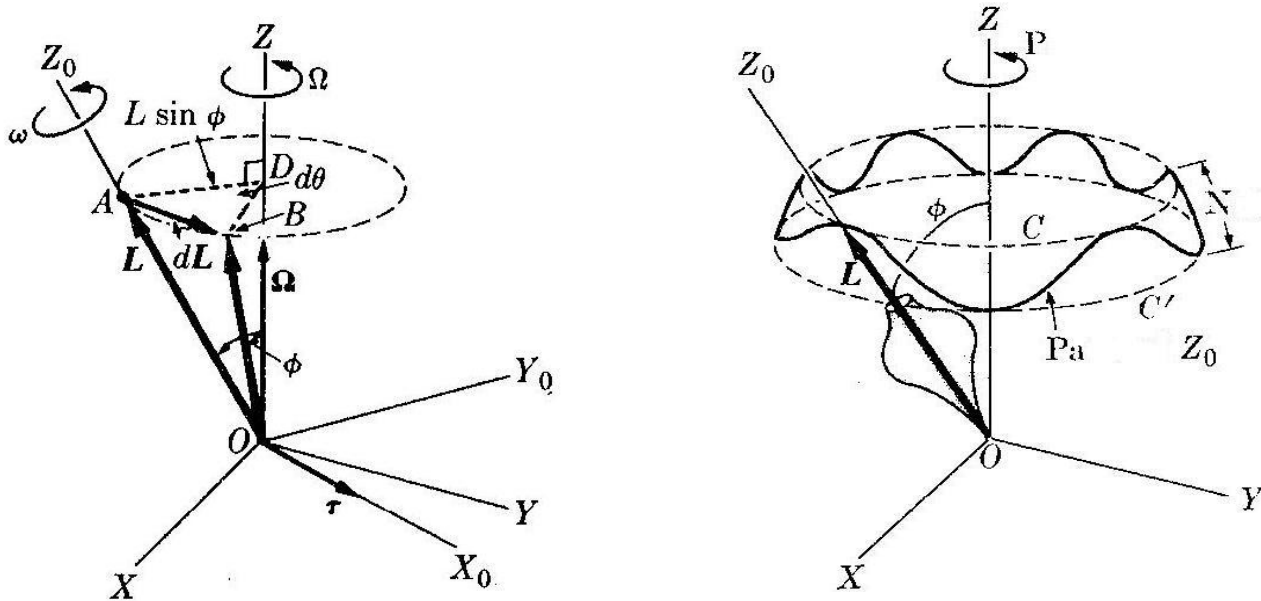
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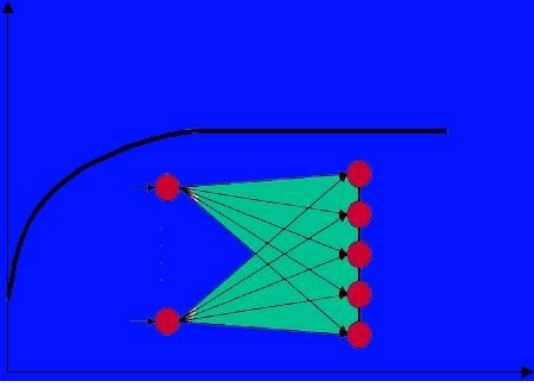
## ADVANCED “NUCLEAR MAGNETIC RESONANCE” PETROPHYSICS

May 2018

Munich

Instructor: Pedro Romero





# GeoNeurale

## ADVANCED “NUCLEAR MAGNETIC RESONANCE” PETROPHYSICS

MUNICH

at the

*GATE – Munich Technical University Research Center*

May 2018

5 DAYS COURSE

INSTRUCTOR: ***Pedro Romero***

LEVEL: Advanced / Specialized

AUDIENCE: Petrophysicists, Geophysicist, Reservoir Engineers, Geologists.

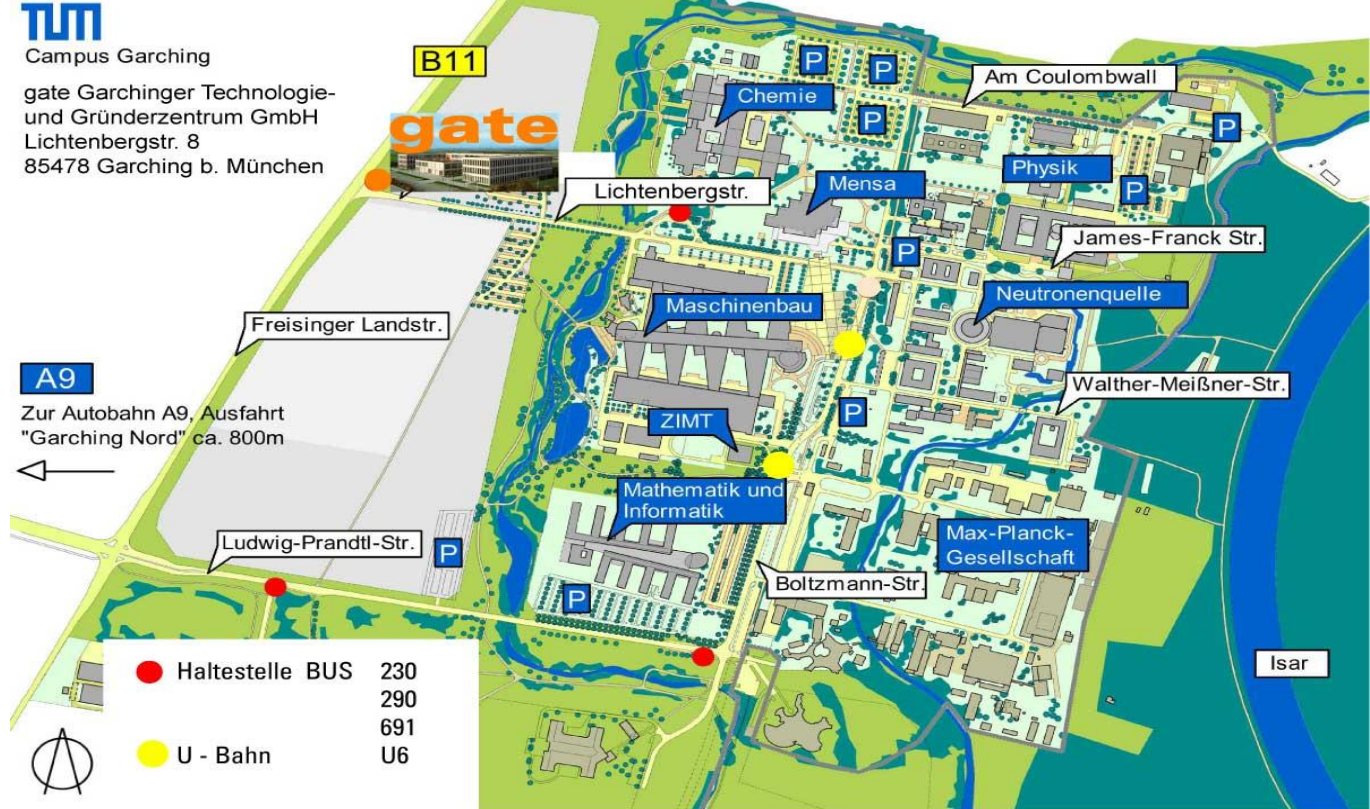
COURSE FEES: 3750 Euro plus 19% VAT (Private companies outside Germany are also allowed to avoid VAT TAX)

# gate



Campus Garching

gate Garchinger Technologie-  
und Gründerzentrum GmbH  
Lichtenbergstr. 8  
85478 Garching b. München



## GeoNeurale Training Location



# ADVANCED COURSE PREPARATION

**Due to the advanced character of this course an online preparation program will start at least two weeks before the course to assist those delegates who would like to review the background theory necessary to face the course with solid concepts of NMR Petrophysics, and related issues.**

## **PROPEDEUTICALS**

As introduction to the analysis of T1 and T2 signals the following themes will be shortly introduced: signal conditioning, Fourier, Laplace and Z transforms, Dirac and Heaviside functions, Hilbert transform and causality conditions, transfer functions, spectra, discrete signals, frequency domain operations, signal and noise, convolution/deconvolution, filters.

# Advanced NMR Petrophysics

**Instructor:** Dr.-Eng. Pedro A. Romero Rojas

Global Geoscience Advisor in Halliburton Deep Water Solution

## Course outline

### 1. Day

Introduction to general algorithms and petrophysical concepts in the context of the oil exploration geosciences. Integration with other disciplines.

### 2. Day

NMR Physics: Spin system, energy levels, resonance phenomenon, T1 and T2 relaxations.

NMR Signal: Echo trains, multiexponential decay, noise, ringing, inversion.

### 3. Day

NMR tools: laboratory and logging tools (WL and LWD).

NMR of bulk fluids: water, Tar, heavy oil, light oil, gas.

NMR of fluids in porous media: water as wetting or non-wetting phase, magnetic field gradient effect on hydrocarbons.

## **4. Day**

NMR Petrophysic models: Porosity model, permeability models, invaded zone saturations, 1D- and 2D-NMR.

NMR Petrophysical evaluations: Sandstone, Carbonate, Shales.

## **5. Day**

Case Studies from the literature: Heavy oil, carbonates, core-log Integration.

New NMR evaluation techniques by means of Machine learning tools: Artificial Neural Nets, High Order Statistics.

# Biography

Pedro Romero is a researcher who dedicated his career to the development of the NMR technologies for petrophysical applications.

He obtained his MSc in Experimental Physics in 1985 at the University of Siegen in Germany and his Ph.D degree in Electrical Engineering at the University of Siegen.

Hi works presently as a NMR Subject\_Matter\_Expert and Global Geoscience Advisor for Halliburton.

His career development is described below.

## *Areas of Expertise*

### Petrophysics:

Statistics and Machine Learning applied to log analysis and data integration.

Developments of procedures for determine fluid typing and rock quality based on NMR, conventional logs and data from SCAL and RCAL.

### Project Management:

R&D project coordinator at Halliburton Brazil Technology Center.

Presalt Carbonate characterization based on multivariate log analysis (2010-2012 at Rio Research and Technology Center of Baker Hughes Incorporate).

Petrophysics for mature reservoirs (2003-04, University of Bahia, Brazil, sponsored by Brazilian Counsel for Research, CNPq).

Rock fluid interaction (2000-2002, PDVSA-Intevep).

### Material Sciences:

Dielectric Spectroscopy.

Assessment of electrical conductivity of high voltage insulating materials.

### Nuclear Physics:

Analysis of heavy ions fragmentation processes in plastic detectors using digital image processing techniques.

### Optics, Electronics and Automation:

Analog and Digital Hardware Development.

Optical Fourier Interferometry.

### Scientific Advisor:

Several theses (BSc. and MSc.).

## ***Record of Employment***

### **Brazil:**

2012-present: Project coordinator and Technical Advisor-Engineering/Petrophysics

Applications, Chief at Halliburton Brazil Technology Center.

2010-12 (May): Geoscience Advisor for the Rio Technology Center of Baker Hughes Incorporated (BHI-RTC).

2008-10 : Geoscience Advisor of Brazilian and Latin America for BHI's Geomarkets and business support for National and International Oil Companies.

### **Argentina:**

2006-08

Global Geoscience Advisor of the Global Geoscience Group at Baker Hughes, division Baker Atlas, in Integrating NMR, Lithology and Conventional Logs by means of Statistics and Data Mining.

Technical Training and Marketing support for NMR and Formation-Lithology technologies. Geoscience-business support for (YPF-Repsol, Occidental).

### **USA:**

2005-06

NMR-Scientist in Houston Technology Center (Baker Atlas-INTEQ):

Development of statistical methodologies for NMR and conventional log interpretations.

2004-05

Geoscience Advisor, Global Geoscience Group, Baker Hughes, division Baker Atlas (Houston): NMR logging applications.

### **Brazil:**

2003-2004

Research Fellowship at the Federal University of Bahía, Salvador, Brazil: Coordination of R&D research activities in petrophysics of the project: *Petrophysical Characterization of Reservoirs and Alterations Generated in Faulted Zones*.

Sponsor: The National Council of Scientific and Technological Development of Brazil (CNPq).

Main research topics: NMR, Induction Polarization (IP), characterization of core and fluid samples, well log analysis.

Lecturer for undergraduate course on: *Physical Properties of Rocks* and postgraduate course in *Applications of Low Field NMR in Petrophysics*.

### **Venezuela:**

1996-2003

Petrophysicist for R&D at Intevep, S.A. (PDVSA), Venezuela:

Project manager for *New Technologies in Petrophysics*: R&D and field studies support for El Furrial, Santa Bárbara, Carito, Barinas (carbonates), Lagomar, Centrolago and Melones (heavy oil) fields.

Development and application of NMR laboratory methods for fluid characterization. NMR based rock quality characterization (lithofacies, petrofacies).

Development of experimental methods and applications of electrical measuring techniques for estimation of the frequency dependence of water and oil saturations in core plug samples.



Generation of pseudo-well-logs based on 3D seismic attributes, key well logs and core data using artificial intelligence (neural nets).  
Conventional log evaluation.

Industrial tutorial of 22 undergraduate/Msc. thesis in cooperation with universities.

Fifteen (15) international publications in SPE, SCA, AAPG, SBGF, SVG conferences.

Venezuela-Germany (transition period Academia-Oil Industry):

1994-1995

Private Lecturer and Research Advisor.

Germany:

1987-1993

Scientific Assistant Professor at the Department of Materials used in Electrical Engineering, University of Siegen, Germany:

Lecturer for *Materials used in Electrical Engineering, Insulating Materials and High Voltage Techniques*".

Development of electronic methods for assessing the electrical insulating behaviour of polyethylene insulated high voltage cables.

Tutorial of fifteen (15) undergraduate/MSc. thesis.

Twelve (12) technical papers in international conferences.

1986

Scientific Assistant of Professor at the Department of Experimental Physics at the University of Siegen:

Study of heavy ions interactions in plastic nuclear detectors using digital image processing techniques.

## ***US-Patents and Patent Filings***

- *NMR-DNA fingerprint* U.S. Patent Application Serial No. 13/196,443, filed August 2, 2011.
- *Viscosity Determination from Logarithmic Mean Ratio of Relaxation Times*, Pub. No.: WO/2008/134769, Pub. Date: 06.11.2008, Int. Appl. No.: PCT/US2008/062171.
- *Method and computer program product for determining a degree of similarity between well log data*, Pub. No.: WO/2009/018040, Pub. Date: 05.02.2009.  
Int. Appl. No.: PCT/US2008/070848
- *Methodology for Interpretation and Analysis of NMR Distributions*, Pub. No.: US 2009/0189604 A1, Pub. Date: 07.30.2009.
- *Acoustic Modified NMR (AMNMR)*: Pub. No.: WO/2009/108876, Pub. Date: 03.09.2009, Int. Appl. No.: PCT/US2009/035508.
- *Nuclear Magnetic Resonance Evaluation Using Independent Component Analysis (ICA)-Based Blind Source Separation*, Pub. No.: WO/2009/038744, Pub. Date: 26.03.2009, Int. Appl. No.: PCT/US2008/010867 2009.

Several papers on Reservoir Characterization (1996-2009) (AAPG, SPWLA, SPE, SCA, SBGF, SVG).

List of selected publications

**Determination of Grain Size Distribution in a Turbiditic Heavy Oil Field From Brazil Offshore Based on LWD Data -NMR and Electrical Images**

Pedro Romero, Katharine Sandler-Klein and Marianne Iversen.

Accepted for the World Heavy Oil Congress 2012, paper 407. Aberdeen, Scotland, UK.

**A new generation of core-sampling options for deepwater environments. Experiences from Brazil**

Pedro Romero, Jeremy Lofts, Omar Lovera, Dan Georgi

52nd SPWLA Annual Symposium. May 14–18, 2011, Colorado Springs, USA.

**Fluid Typing from NMR Logging with a Gradient Magnetic Field**

Pedro Romero, Qian Zhang

2010 Rio Oil & Gas Expo and Conference, Rio de Janeiro, 13-16 September, Brazil

**Determination of heavy oil viscosity as a function of the ratio of log means of T1 to T2 NMR relaxation times distributions**

Pedro A. Romero, Benito Saavedra, Hyung T. Kwak and Gabor Hursan

2009 Conference of the Society of Exploration Geophysics, CPS/SEG Beijing, China.

**New NMR-based Methodology for Inferring the Presence of Movable Heavy oil in Reservoir Layers**

Pedro A. Romero, Nestor Acosta and Hiram Serrano

AAPG International Conference and Exhibition, Rio de Janeiro, Brazil, November 15-18, 2009.

**Applications of 2D-NMR Maps and Geometric Pore Scale Modeling for Petrophysical Evaluation of a Gas Well**

Pedro A. Romero, Mikhail Gladkikh and Guillermo Azpiroz

AAPG Annual Convention, San Antonio, TX, April 20-23, 2008.

**Pore-scale Characterization and Productivity Analysis by Integration of NMR and Open hole Logs –A Verification Study-**

Tania Galarza, Sergio Giordano, Michael Fontanarosa, Marcelo Saubidet, Mehmet Altunbay, Benito Saavedra, Pedro Romero

2007 SPE Latin American and Caribbean Petroleum Engineering Conference held in Buenos Aires, Argentina, 15–18 April 2007.

**Method for Characterization of Rock Quality Based on Winland-Pittman and Timur-Cotes Equations Applied to NMR Laboratory Data**

Pedro A. Romero (at University of Bahia, Brazil), Nathalí Gómez

45th SPWLA Annual Logging Symposium, Jun. 6-9, 2004, Noordwijk, The Netherlands.

**Determination of Rock Quality in Sandstone Core plug Samples Using NMR**

Pedro Romero (at PDVSA-Intevep), Gabriela Bruzual, Ovidio Suarez

2002 International Symposium of the Society of Core Analysts, paper SCA2002-51, Monterey, CA, USA.

Several papers on Dielectric Materials applied in High Voltage Fields (1987-1995).

## ***International Lectures***

1. *Basics of NMR Logging Technologies*, short course sponsored by Petrobras, Statoil and Repsol at ABGP (Brazilian Association of Petroleum Geologists) August 2011 and April 2012. Next course will be held in April 2013.
2. *Basics of NMR Logging Technologies*, short course sponsored by Baker Hughes and SPWLA for Petrobras Rio de Janeiro, Petroleum Institute of State University of North of Fluminense (UENF-LENEP) and Observatorio Nacional (National Observatory), Rio de Janeiro, Brazil, March-April, 2010.
3. Short course – SPWLA Brazil-Chapter: *Resonância Magnética Nuclear aplicada na avaliação da formação*; Dr. Pedro A. Romero – Baker Hughes.
4. *Characterization of Heavy Oil using NMR*, SPWLA Chapter Rio de Janeiro and Macaé Chapters, Brazil, April, 2010.
5. *NNMR for Rock and fluid typing*, Petroleum Institute of the Herriot-Watt University, Edinburgh, U.K., November 2009.
6. *Application of low field NMR in petrophysics and fluid characterization* Federal University of Rio de Janeiro, April 16<sup>th</sup>, 2009.
7. *2D-NMR applications for fluid identification and permeability correction in heavy oil zones*, The Brazil Chapter of SPWLA, Rio de Janeiro, Brazil, August 19<sup>th</sup>, 2008.
8. *Applications of low field NMR for characterization of reservoirs fluid and core samples at:*
  1. Geophysical Institute of the University of Karlsruhe, WIP, Germany 2004.
  2. University of Siegen, Electrical Engineering Department, 2004.
  3. Institut Français du Pétrole (IFP), Paris, France, 2004.
  4. Exploration and Production Reservoir Business Unit of Petrobras, Salvador, Bahia, Brazil, 2004.
9. *Principles of Nuclear Magnetic Resonance in fluids and reservoir characterization*, SPE International Thermal Operations and Heavy Oil Symposium, Porlamar, Margarita, Venezuela, 2001.
10. *Diagnostic methods of water trees*, University of Seville, Informatics Engineering and Applied Physics Department, Seville, Spain, 1995.
11. *Diagnostic methods of water trees*, Simón Bolívar University, Electrical Engineering Faculty, Caracas, Venezuela, 1995.
12. *Analysis of polarization processes in water trees in time and frequency domain (Untersuchung von Polarisationsprozessen in Water Trees im Zeit- und Frequenzbereich)*, Workshop: Aktuelle Probleme der Energietechnik, ETH-Zürich, Switzerland, January 1994.

## ***Membership in Professional Societies***

IEEE (Vice-Chairman for IEEE section at OTC-2013 in Rio de Janeiro)

SPWLA (Vice-President of Brazil-chapter until November, 2011)

SPE.

ABGP (Training facilitator of the Brazilian Society of Petroleum Geologists). [http://www.abgp.com.br/cartas/flyer\\_aplic\\_tecnologicas\\_20110603.html](http://www.abgp.com.br/cartas/flyer_aplic_tecnologicas_20110603.html)

## ***Awards***

*Baker Hughes' Subject Matter Expert for NMR logging technology, January 2012.*

*Lifetime Featured Member of America's Registry of Outstanding Professionals, 2011.*

*Oil and Gas/Geoscience Professional of the Year 2009, Strathmore's Who's Who Worldwide:*

[http://www.strathmoreworldwide.com/profoftheyear\\_bio.asp?id=306843&industry=Oil%20and%20Gas/Geoscience](http://www.strathmoreworldwide.com/profoftheyear_bio.asp?id=306843&industry=Oil%20and%20Gas/Geoscience)

*Geoscience Professional of the Year 2008, Strathmore's Who's Who:* [http://www.strathmore-](http://www.strathmore-td.com/profoftheyear_bio.asp?id=109174&industry=Geoscience)

[td.com/profoftheyear\\_bio.asp?id=109174&industry=Geoscience](http://www.strathmore-td.com/profoftheyear_bio.asp?id=109174&industry=Geoscience)

*Global Geoscience Consulting Professional of the Year 2008 America's Registry of Outstanding*

*Professionals:* <http://www.americasregistry.com/profoftheyear.asp?iYear=2008>

# Registration Details

•Course fees: 3750 Euro + 19% VAT (Private companies outside Germany are also allowed to avoid VAT TAX)

•Registration deadline : 15 April 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 agreed, 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

Am Nymphenbad 8

81245 Munich

T +49 89 8969 1118

F +49 89 8969 1117

ONLINE REGISTRATION: [www.GeoNeurale.com](http://www.GeoNeurale.com)

Please indicate your name and the purpose: " Advanced NMR Petrophysics ".

[www.GeoNeurale.com](http://www.GeoNeurale.com)

## 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.

Cancellations 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 32 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 annulment (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 : airplane or airport 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.

**AGREEMENT:** Upon enrollment all parties 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.

## **REGISTRATION FORM**

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

### **ADVANCED NMR PETROPHYSICS**

**Munich, May 2018**

**Course Fee: 3750 Euro plus 19% VAT** (Private companies outside Germany are also allowed to avoid VAT Tax)

Name:

Company:

Address:

Job Title:

Phone:

Fax:

Email:

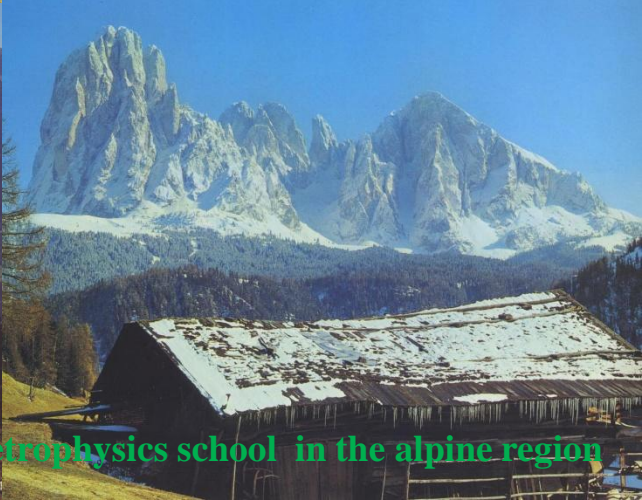
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[www.GeoNeurale.com](http://www.GeoNeurale.com)



**After the courses:**  
**GeoNeurale organizes geological field trips on the Alps. Informations and registrations: [courses@geoneurale.com](mailto:courses@geoneurale.com)**





A Petrophysics school in the alpine region