GeoNeurale

Presents

Leon Thomsen and Robert Garotta

Hybrid Course

3D Seismic Multi-Component and Seismic Anisotropy

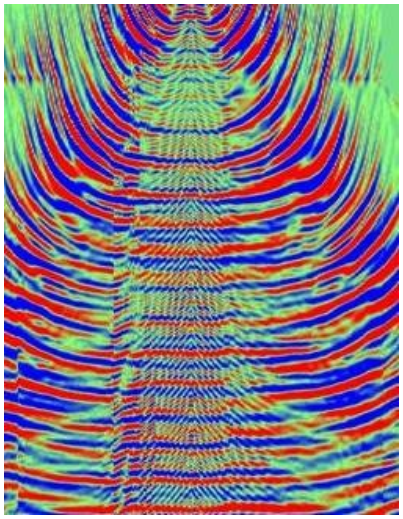
Leon Thomsen & Robert Garotta

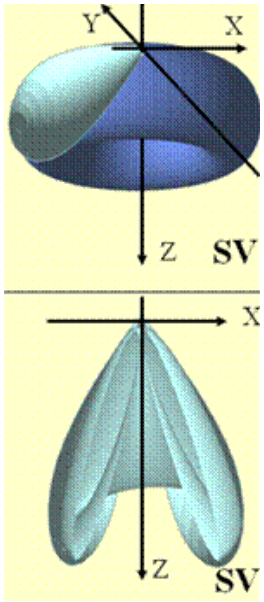
The event of the Year in Munich

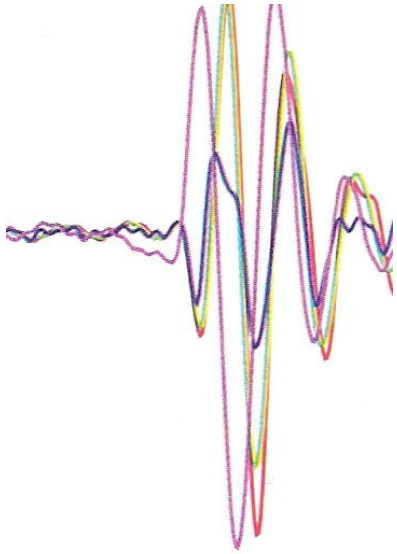
Seismic anistropy is usually small, but sometimes leads to large effects in the data, particularly in shear and converted waves.

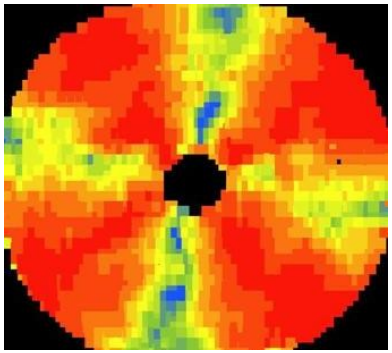
A complete treatment of anisotropy and multi-component seismics, and their implications, along with the latest developments in research in these areas, are presented and discussed together by two senior scientists who are behind a great part of the development of this technology.

The course starts with 3D Seismic Multi-Component (2,5 days) and continues with 3D Seismic Anisotropy (2,5 days) . Both scientists are avaliable during the course for questions, feed-back and interactive discussion with the audience.









Robert Garotta:
3D Seismic Multi-Component is the approach to rock physics through seismic inversion and anisotropy analysis

Leon Thomsen:
Anisotropy is the long wave expression of small scale heterogeneity with preferred orientation.
It is ubiquitous, effecting all wave-types.

PROPRIETARY CONSULTING SERVICES

For the companies sending at least 3 Delegates to the course:

Leon Thomsen and/or Robert Garotta

- offer proprietary consulting at the concessionary rate of 2000 Euro/day (plus expenses) up to 3 days. (If the consultation is scheduled in the same time frame as the course, some travel expenses may be avoided.)
- Appropriate Confidentiality Agreements will be executed prior to such consultation.
- Companies desiring such consulting arrangements should so indicate to Geoneurale.

GeoNeurale

MUNICH

at the

GATE – Garchinger Technologie und Gründerzentrum

5 – 9 December 2011

5 DAYS COURSE

- INSTRUCTORS: Robert Garotta and Leon Thomsen
- LEVEL: Advanced / Specialist
- AUDIENCE: Seismic Interpreters, Processors, and Imagers; Geophysicists, Reservoir Engineers.

- COURSE FEE: 3800 Euro + VAT (19%)
- REGISTRATION DEADLINE : 5 November 2011
- ONLINE REGISTRATION: www.GeoNeurale.com

3D SEISMIC MULTI-COMPONENT (Robert Garotta)

- The first two days of the course will be devoted to the presentation of the basic theory of elastic propagation and its consequences about the acquisition and the processing of multi-component data, then to the presentation of 2D and 3D examples of results.
- During the third day more details will be given to particular topics:
- - shear mode static corrections,
- - derivation and use of the Vp/Vs ratios,
- - simultaneous combined PP and PS mode inversion,
- - detection and compensation of azimuthal anisotropy.

3D SEISMIC ANISOTROPY (Leon Thomsen)

Course Description

All rock masses are seismically anisotropic, but we generally ignore this in our seismic acquisition, processing, and interpretation. The anisotropy nonetheless does affect our data, in ways that limit the effectiveness with which we can use it, so long as we ignore it. In this short course, we will understand why this inconsistency between reality and practice has been so successful in the past, and why it will be less successful in the future, as we acquire better seismic data (especially including vector seismic data), and correspondingly higher expectations of it. We will further understand how we can modify our practice so as to more fully realize the potential inherent in our data, through algorithms, which recognize the fact of seismic anisotropy.

3D SEISMIC MULTI-COMPONENT (Robert Garotta)

- **Section 1 Historical overview**
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- - Scientists
- - Earthquake seismologists
- - Civil engineers
- - Exploration geophysicists
-
- **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 Shear wave acquisition**
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- - Shear wave sources
- - Land multi-component receivers
- - Shear wave land acquisition
- - PS mode land acquisition specifics
- - Shear wave marine and shallow water acquisition

- **Section 5 Processing of shear wave data**
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- - Generalities about Shear mode processing in VTI environment
- - Static corrections
- - Normal moveout corrections
- - 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
- - Correlation of P and S data
-
- **Section 6 Results of shear waves surveys**
-
- - Poisson's ratio derivation from P and SH surveys
- - Poisson's ratio derivation from P and PSV surveys
- - Example of gas detection
- - Wave mode comparisons
- - Improving the seismic image
- - 3Dx3C and 2Dx3C azimuthal anisotropy surveys
-
- **Conclusions**

3D Seismic Anisotropy (Leon Thomsen)

- **1.Physical principles (Day 3, afternon)**
- **2.P-waves: imaging (Day 4)**
- **3.P-waves: characterization (Day 5, morning)**
- **4.S-waves, C-waves: (Day 5, afternoon)**
- **Epilogue: (Day 2, afternoon)**

DISCUSSION

At the final discussion, both Instructors participate, and the Geoscientists can pose questions related to their specific processing and interpretation problems.

- **BIOGRAPHY**

- **Robert Garotta**

  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 company.

  Robert is still advising the CGGVeritas group in the area of Multi-Component seismic.

- Awards:
- - Conrad Schlumberger Award from EAEG 1965
- - Prix Charles Bihoreau 1975
- - SEG Distinguished Instructor 2000
- - SEG Honorary Member 2001

BIOGRAPHY

- *Leon Thomsen*

Leon Thomsen holds degrees in geophysics from Caltech (B.S. 1964) and Columbia (Ph.D. 1969). His academic career began with post-doctoral appointments at CNRS in Paris, and at Caltech, followed by faculty appointments at the State University of New York in Binghamton (1972-80).

Thomsen's industrial career began with 14 years at Amoco, at its famous Tulsa Research Center. Following the change of its mission in 1994, he joined Amoco's worldwide exploration department in Houston. Following the merger with BP, he served in BP Amoco's Upstream Technology Group in Houston, as Principal Geophysicist. He retired from BP in 2008, and founded the international consultancy Delta Geophysics; he also is Research Professor at the University of Houston, and Visiting Scientist at Lawrence Berkeley National Laboaratory

For his work in seismic anisotropy, Thomsen was given the Fessenden Award in 1994 by the SEG. He served as the SEG Distinguished Lecturer in 1997, and was Chairman of the Research Committee in 1998-2000. He served as SEG/EAGE Distinguished Instructor in 2002. He served the worldwide Society of Exploration Geophysics as President in 2006-07; in this role he was the *de facto* head of the international profession of applied geophysics.

He and his colleagues received the EAGE's Best Paper Award in 1997 for their converted-wave analysis at Valhall. Thomsen was given Honorary Membership in the GSH in 1998and in the EAGE in 2003. He is a Foreign Member of the Russian Academy of Natural Sciences, and holder of their Kapitsa Medal.

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

- ***3DSeismic Multi-Component and 3D Seismic Anisotropy***
- Munich, 5 – 9 December 2011
- Course Fee: 3800 Euro + 19 % VAT **(VAT Tax is 100% refunded from the German Finance Ministry)**

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

- SIGNATURE: _____

- Registration Details

- Course fee: 3800 Euro + 19% VAT
- Registration deadline : 5 November 2011

- **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
- Lichtenbergstrasse 8
- D-85748 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: “Seismic Anisotropy and Multi-Component course fee".

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 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 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 : 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 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.

GEOLOGICAL EXCURSION

- **The course is followed on Saturday by an optional excursion to the carbonates of the local Bavarian Alps "Karwendelgebirge", with stops at the Bavarian Castles of Neuschwanstein and Linderhof.**

PROGRAM and FOTOS