Société pour l'Avancement de l'Interprétation des Diagraphies
Section française de la SPWLA "Society of Petrophysicists and Well Log Analysts"

S.A.I.D. TECHNICAL SESSION :

BOREHOLE SEISMIC / SISMIQUE DE PUITS

Thursday, April 5 2018: 15:00-18:00

Salle Ver Straelen, SGF
77 Rue Claude Bernard, 75005 Paris
Access map on page 2 ; Abstracts on pages 3 to 7,
Speakers and contributors on page 8 & 9
Web site : http://www.la-said.org
Mandatory registration by email to : vice-president@la-said.org

Possibility to follow the meeting via a Web Lync through the same registration .
Specify your name, company, job, email and telephone to get an invitation.

15:00 – 15:05 Welcome , Safety and Introductory remarks

Introduction

1. **15:05 – 15:20 : Basic Borehole Seismic**
   Jean-Claude PUECH , Schlumberger

Technologies Session :

2. **15:20 – 15:35 : « What's needed, What's New, What's Next », AVALON Geosciences :** Gary TUBRIDY – William WILLS, presented by Charles NAVILLE, **IFP-EN**

3. **15:35 – 15:50 : New acquisition technologies for VSP and Microseismic with conventional hardware and Fiber optical Distributed Acoustic Sensing (DAS,** Oleg VALISHIN, Florian PERCHER , **SERCEL**

Case Studies Session :

4. **15:50 – 16:20 : 4. Borehole seismic applications from operator's perspective,** Michel VERLIAC , **TOTAL**

16:20 – 16:50 : Coffee Break

16:50 – 17:00 : Information about SAID

5. **17:00 – 17:30 : Log of Formation Parameters While Drilling ,** Sylvain SERBUTOVIEZ, **IFP-EN**

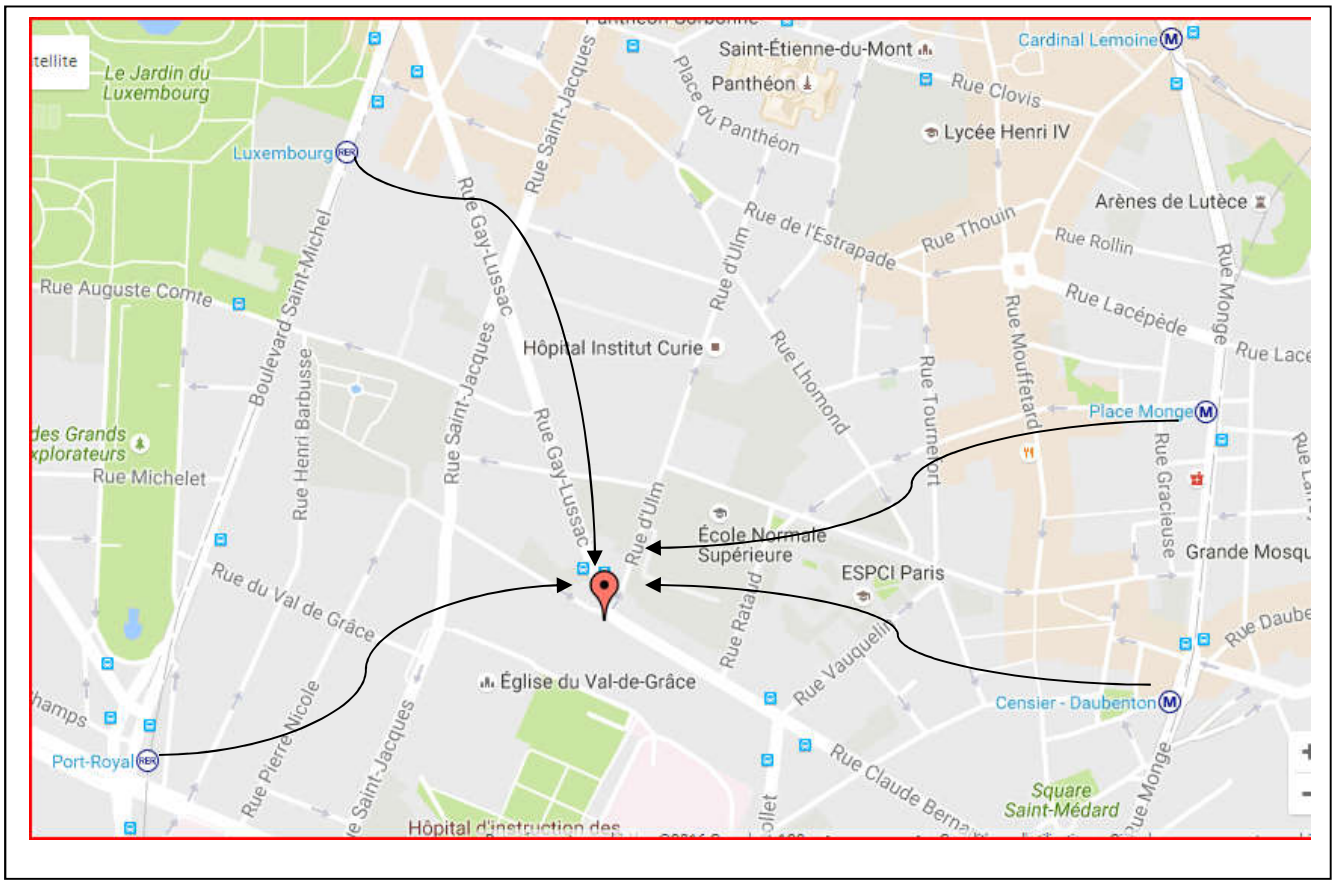
6. **17:30 – 18:00 Orientation of 3 component Rig-source VSPs, IFPEN-APS-PPZG,** Charles NAVILLE, **IFP-EN**

Location of the meeting :
Salle Ver Straelen, SGF ,
Société Géologique de France
Maison de la Géologie
77 Rue Claude Bernard, 75005 PARIS
Web site : http://geosoc.fr

Pour entrer, appuyer simplement sur le bouton et pousser la porte (Ne pas composer de code) ; Bâtiment au fond de l'allée, salle à droite au RDC.

To enter, just push the button and push the door ; Do not type any code ;
Room on the right as you enter the building .

Plan d'accès/ Access map :
A partir du RER-B Station Luxembourg , via Rue Gay-Lussac
A partir du RER-B Station Port Royal via Rue St Jacques
A partir des métros Censier-Dobanton ou Place Monge (Ligne 7 La Courneuve-mairie- d'Ivry)
Egalement par Bus RATP .(Val de Grâce ou Luxembourg)



ABSTRACTS

1. **Basic Borehole Seismic**
   Jean-Claude PUECH , **SCHLUMBERGER**

"Did you say VSP? What for ?"
A tour of the technique will be given, emphasizing what a geoscientist can expect and obtain out of this singular well logging measurement. The presentation will review the different applications, moving gradually from simple to more advanced ones, and illustrating them with real life examples.

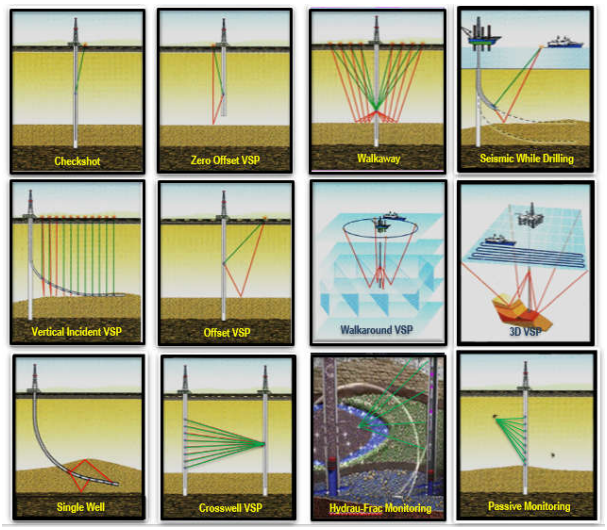
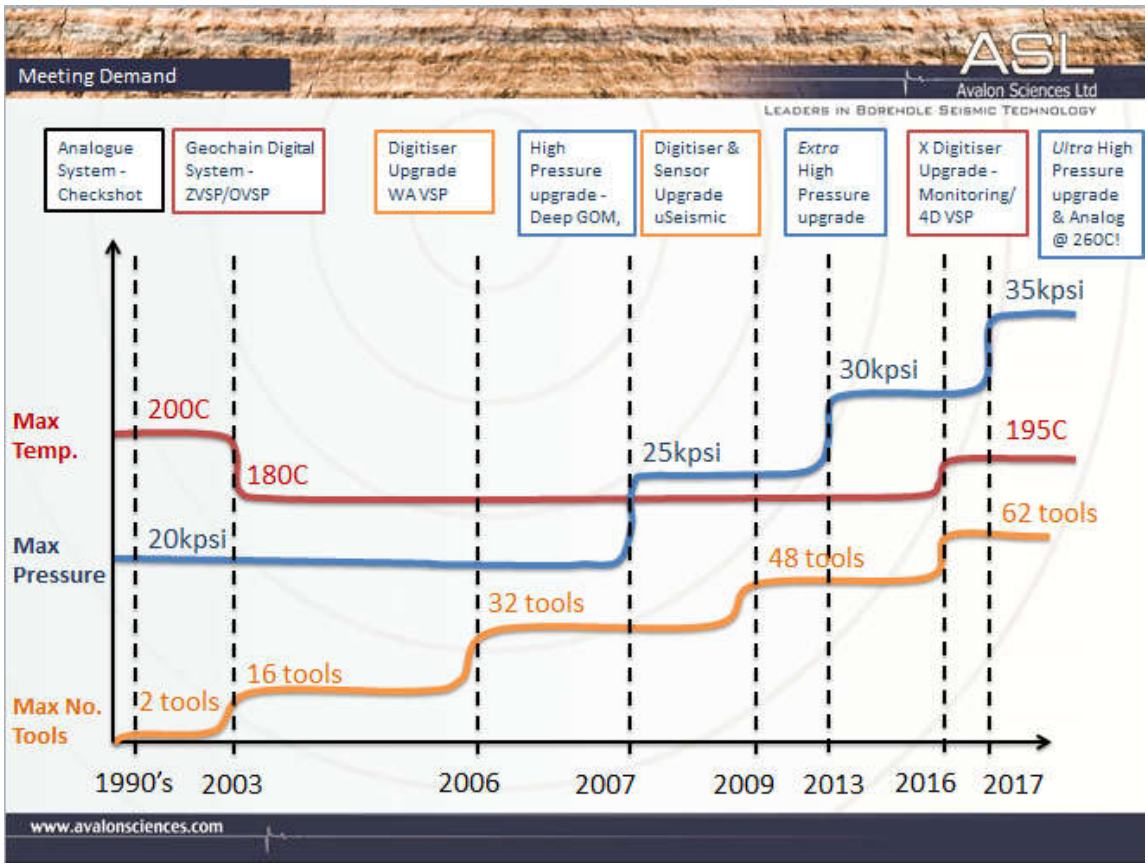
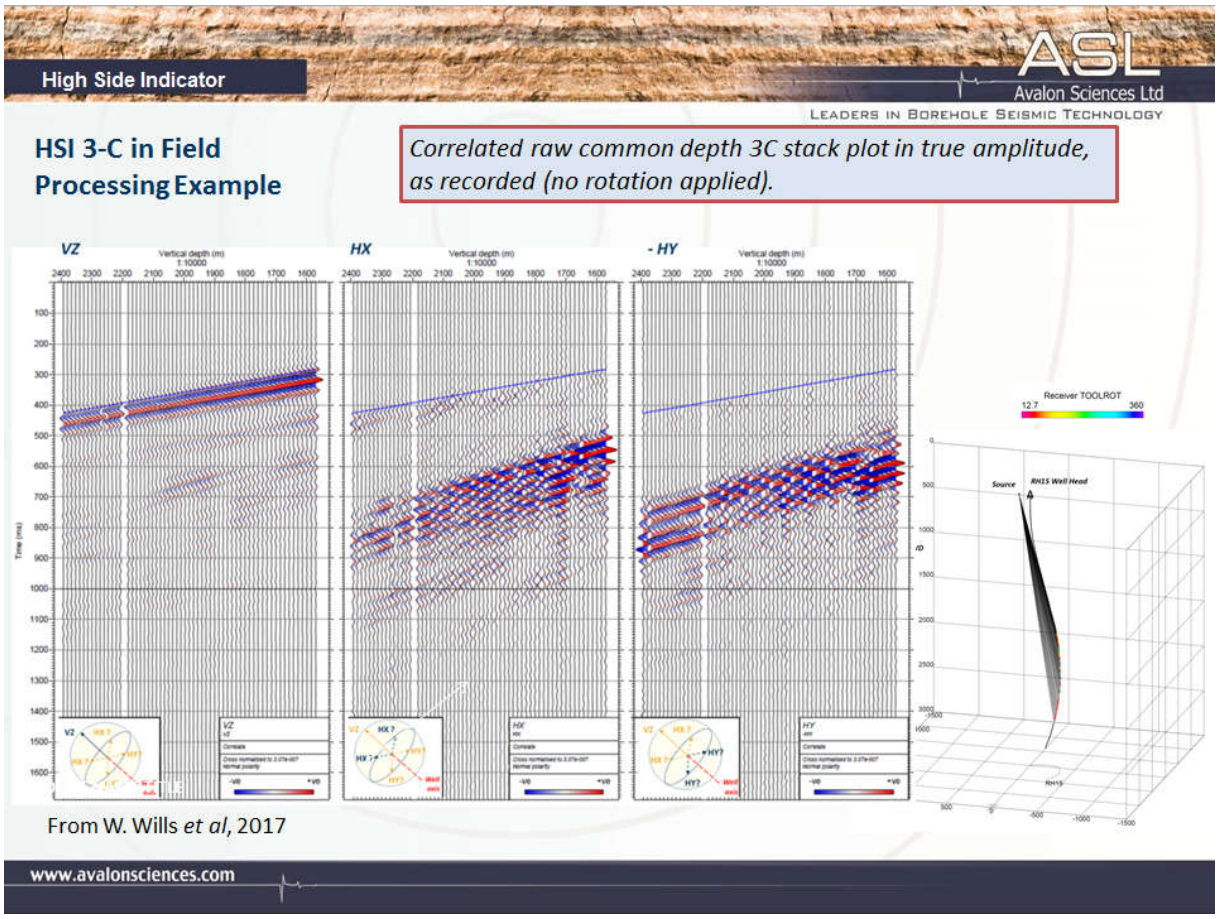


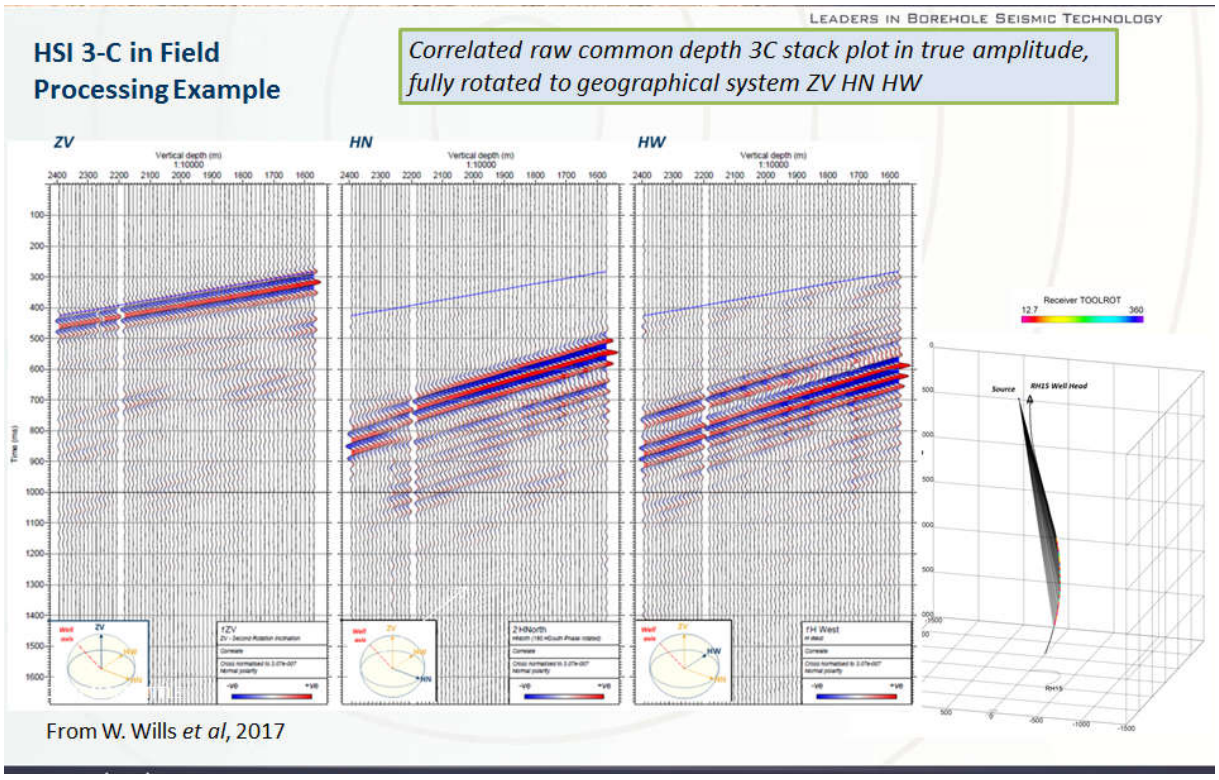
Plate showing the different configurations used in Borehole Seismic, depending of the purpose and the geological context.

2. **« What's needed, What's New, What's Next », AVALON Geosciences :** Gary TUBRIDY – William WILLS, presented by Charles NAVILLE , **IFP-EN.**
   PDF : 2018 SAID Avalon_Sc_Ltd-VSP Tech Talk v2.pdf (see www.la-said.org)



Example of 3C orientation of rig source VSP dataset, orientation QC on the field:





3. **New acquisition technologies for VSP and Microseismic with conventional hardware and Fiber optical Distributed Acoustic Sensing (DAS),** Oleg VALISHIN, Florian PERCHER , **SERCEL**

The development of downhole seismic tool and technologies of their use has significantly advanced in the last few years. Current arrays system are capable of handling up to 120 shuttles on conventional wireline, with up to 3000 meters well coverage. The pressure and temperature limits have been pushed up dramatically, up to 35,000 psi and 205 degC for digital tools. The operations offshore with 100 levels and > 50,000 shooting points are not considered exceptional anymore. The rig up time, one of the primary issues of the VSP applications have been significantly reduced due to novelty deployment methods.
On the microseismic monitoring, split arrays with up to 1000 meters wellbore coverage become a norm for HFM, while improved electronics and increased number of geophones per tool allow microseismic detection in the conditions where it was not feasible before.
The advent of the Distributed Acoustic Sensing brought a new dimension to the borehole seismic, empowering certain applications, but confusing many users. A certain tendency has been widely used to present "either geophones or DAS" approach, while ignoring the final value of the measurement to the data user. Sercel will present their view on the matter, where both of the technologies can be, and should be used as complementary to each other, depending on the customer needs and the level of technology.

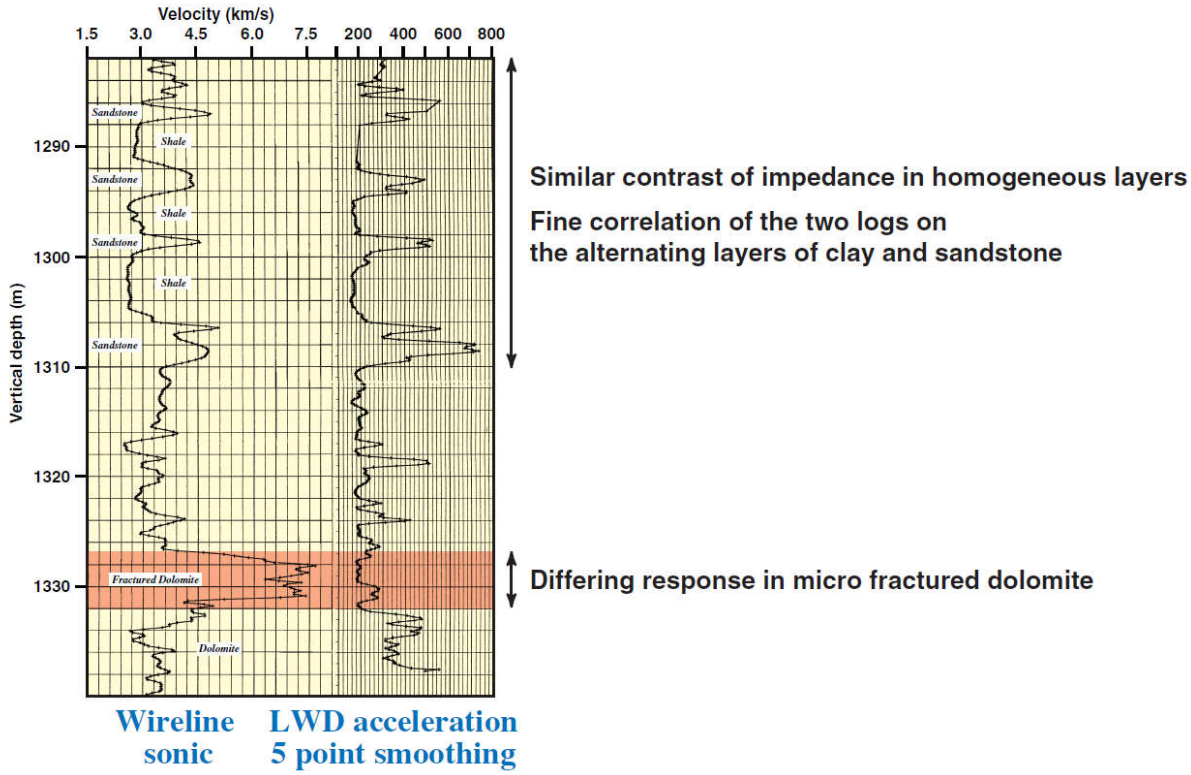
4. **Borehole seismic applications from operator's perspective,** Michel VERLIAC , **TOTAL**

Overview of recent applications of borehole seismic for field exploration and development within Total, including examples of use of VSP to improve drilling decisions, structural delineation in complex geological environment, guidance of surface seismic processing, etc.

5. **LOG OF FORMATION PARAMETERS WHILE DRILLING,** Sylvain SERBUTOVIEZ, **IFP-EN**

ABSTRACT: The variations of formation stiffness are tentatively quantified using mainly the axial drill bit acceleration compensated with the appropriate drilling parameters in order to produce a continuous log while drilling. The acceleration sensor is preferably located down hole, at close as possible to the rook bit, up to 30m behind it. In the examples shown, the root mean square acceleration is calculated over every drilling time segment of 30 seconds, then it is displayed versus Measured Depth. Simple compensations are applied with the drilling rotation (RPM) and the rate of penetration (ROP) recorded on the drill site. As the obtained log is closely related to the P-wave acoustic impedance calculated from the standard wire line sonic and density logs, this new log has been called **"Pseudo acoustic Impedance Log" (PI-log)** Comparisons of the pseudo impedance log with the acoustic impedance computed from the sonic and density logs have been produced from several field examples. Good correlation has been obtained in homogenous formations with strong impedance variations. Differences are observed in micro fractured and fractured formations. With a Polycristalline Diamond Compact (PDC) bit, the axial and torsion acceleration logs have been produced, from top of drillstring measurements only, however only the axial acceleration variations seem to be related to the lithology. More accurate experiments need to be carried out with PDC bits using downhole recorders of mechanical parameters While Drilling, in order to assess the value of the present pseudo-log. As the pseudo formation impedance log can be obtained while drilling, related to an " at the bit" measurement it could be a good Real Time indicator of the lithological changes at the bit in real time and could help in the following applications:

· positioning of the drill bit on the seismic section,
· definition of coring/casing points...
· formation evaluation when used with other logs
· early detection of over pressured formation,
. early detection of fractured / brittle rock drilled intervals, as illustrated below: the pseudo-impedance log on the right track, obtained with roller cone bit , indicates the weak resistance to drilling in the microfractured, high acoustic impedance dolomite layer underlined in brown.



Reference: AAPG Search and Discovery Article #90906©2001 AAPG Annual Convention, Denver, Colorado

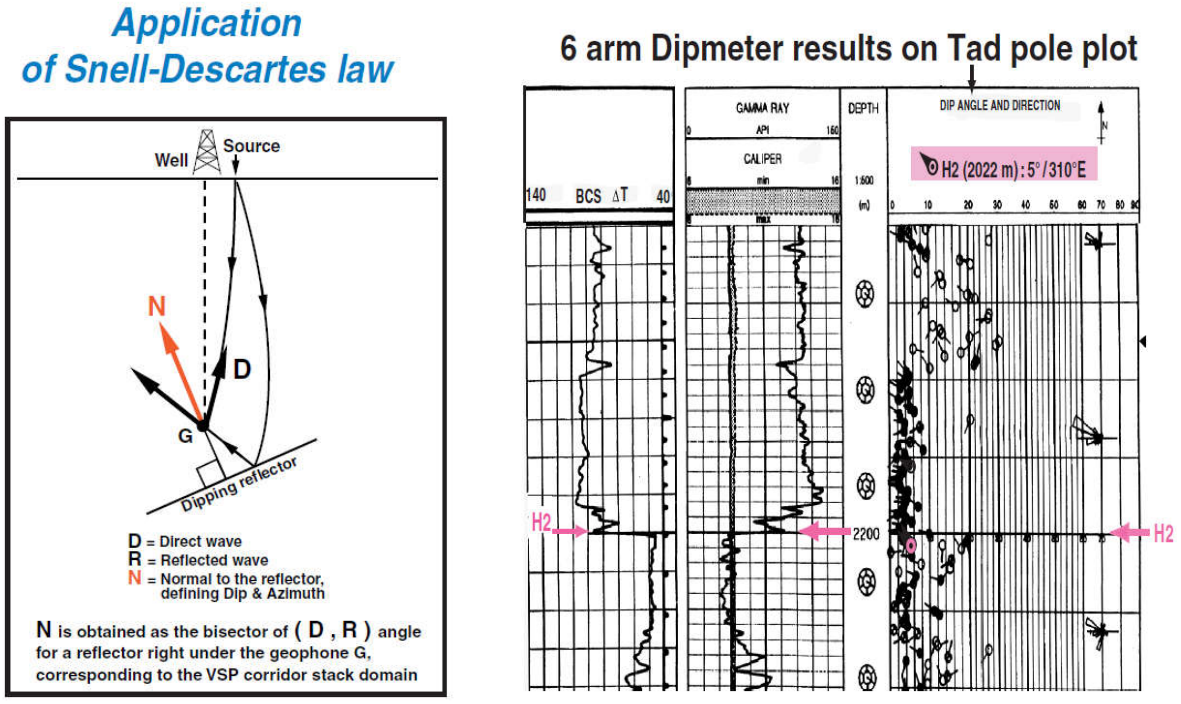
6. **Orientation of 3 component Rig-source VSPs, IFPEN-APS-PPZG,**
   by Charles NAVILLE, **IFP-EN**;

ref: http://www.ifpenergiesnouvelles.com/Expertise/Research-divisions/Geosciences/IFPEN-APS-PPZG-Orientation-of-3-component-Rig-source-VSPs

ABSTRACT summarizing the main application:
SEISDIP : The "VSP dipmeter" from Oriented 3 Components:
VSP surveys are commercially recorded with a single zero-offset source position and with a downhole tool including 3 orthogonal seismic sensors. For VSP acquisition in vertical wells, a hardware orientation accessory needs to be combined with the VSP tool.
The illumination of seismic reflectors is achieved in 3 Dimensions, with information about their dip and azimuth (Seisdip™ method). 3C VSP yields the structural dip of seismic interfaces from the borehole up to distances of several hundred metres away from the well, even if the reflectors do not intersect the well, or are located below the well.
3C VSP can be recorded in cased or open hole. In contrast, electrical dip - meter log measurements relates to sedimentary dips within centimetres away from the well bore, and can be recorded in open hole only.
3C processing of oriented VSP data allows for reliable identification and improved discrimination of the upgoing VSP events: P or S mode, reflected, diffracted or refracted arrivals.

In case of interfering reflected/diffracted events generated by lateral dip variations or tilted faulted blocks, 3C processing allows to fully understand the VSP response, while the conventional single component processing can mislead the interpreter.
After showing a couple of case studies of VSP defined DIP, the presentation will focus on HOW to orientate the VSP tools containing 3 component geophones, WITOUT gyroscope.

Dip/azimuth determination of reflectors near borehole , illustrated on below figure.
Principle of method (left), field example (right), in comparison with resistivity dipmeter log



Courtesy of PETROREP,France

Reference: AAPG Search and Discovery Article #90906©2001 AAPG Annual Convention, Denver, Colorado

About the Speakers and Contributors of the technical session

1. Jean-Claude PUECH , Schlumberger

Principal Geophysicist who has spent the majority of his career in Schlumberger, acting in different countries of Europe and Africa as Borehole Seismic Processor and Team Leader of commercial processing teams.
email : jean-claude.puech0143@orange.fr

2. Gary TUBRIDY, Director, AVALON Sciences Ltd , UK

Formally a VSP Field Engineer and Tool Supervisor at SSL, Gary is now the founding CEO and owner of Avalon Sciences Ltd. For over 20 years Avalon has been at the heart of innovation for borehole seismic technology. Gary has grown the manufacturing operation from a small scale operation to a global business with a full high precision CNC machining factory, research centre and high pressure/high temperature test facility in the UK, with regional support and service bases in Abu Dhabi, Houston, Beijing and Singapore. In 2013 Gary acquired the Rosemanowes Deep Well Borehole Test Facility to further enhance seismic tool research and development.
Contact : Gary@avalonsciences.com

3. William WILLS, Staff Geoscientist , AVALON Sciences Ltd , UK

Initially a geologist, William has been part of the global operations team for over 8 years supporting and managing ASL client service company BHS acquisition and processing operations from the Avalon UK, Gulf of Mexico and Middle East regional bases. William is a member of the EAGE Passive Seismic Workshops technical committee and has over 10 years' experience using Avalon borehole seismic hardware and software for both VSP, Hydraulic fracture and passive seismic monitoring surveys.
Contact : Will.Wills@avalonsciences.com

4. Oleg VALISHIN, SERCEL

Oleg has a Master of Engineering degree in Petroleum Engineering from French Petroleum Institute. He spent 6 years working for Schlumberger in a variety of roles related to wireline logging and borehole seismic acquisition including field operations, and operations management in Africa, Asia and Russia. After leaving Schlumberger he joined Sercel in France, and is currently in charge of the Downhole Seismic Tools business line."
Contact : oleg.valishin@sercel.com

5. Florian PERCHER , SERCEL

6. Michel VERLIAC , TOTAL

7. Sylvain SERBUTOVIEZ, IFP-EN

Graduated from Geology School of Nancy (1986) , IFP School of geophysics (1987).
Computer scientist for IPS (Puteaux) during 3 years, involved in Total, GDF and PetroSystems /CGG reservoir engineering projects
Geophysicist in the R&D Seismic Department of IFP, 14 years in borehole seismic projects.
Upstream Economist for Oil&Gas in the Economics and Information Department of IFPEN:
14 years of techno economics evaluations and market analysis.

8. Charles NAVILLE, IFP-EN

R&D engineer in IFP-Energies Nouvelles. He spent 15yrs in CGG practising various field and processing seismic methods including reflection/refraction surface seismic , and borehole seismic, single and multi-component. Civil engineer from Ecole Polytechnique-1976, ENSPM-1980. Joined CGG in 1977, field assignments in Gabon, USSR, Brazil, USA, then R&D activities. Filed about 15 patents concerning surface seismic, VSP, and Seismic While Drilling /SWD. Present interest in the coherent integration of multiscale results of surface seismic, borehole seismic, logs and geology in the reservoir interval.
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