

Onshore vibroseis VSP in Grigny-GGR5 borehole

ILLUSTRATIONS OF THE FIELD VSP OPERATION

VSP : VERTICAL SEISMIC PROFILE

- GEOFLUID-IFPEN joint Project partially funded by ADEME-IDF



- OBJECTIVES:
 - High seismic frequency (HF) emission for fine prediction of the Dogger aquifer structure using the VSP method.
 - Investigating the local physical limitations of HF seismic propagation.
- Images of the technology operated on and around the rig site.
- Impact of weather conditions on fix source onshore VSP.
- Coordination of the involved service companies.

Participants to the SISMOSUB-ADEME project for the VSP operation conducted on Grigny GGR5 drilling site for GPCIP-GEOFLUID, March 2023



1- **ASL/AVALON** : Steve Bridger, Joe Rawlings, Sebastien Soulas, Gary Tubridy, Will Wills.

VSP Downhole tools and recorder: equipment and field operations.

GTG

2- **GALLEGO TECHNIC Geophysics** : Pierre Gallego, seismic Vibrator source: equipment and field operation.



3- **GPCIP/GEOFLUID** : Ivan Guerbatchouk, Damien Sarda: Drilling Supervision.

4- **SCHLUMBERGER/SDP** : Winch truck : equipment and operator.



VSProwess

5- **VSPROWESS** : Mary Humphries, James Bailey, VSP seismic processing.

6- **GEE**: Groupement des Enrobés de l'Essonne: Farid Messaoudi, Site manager.



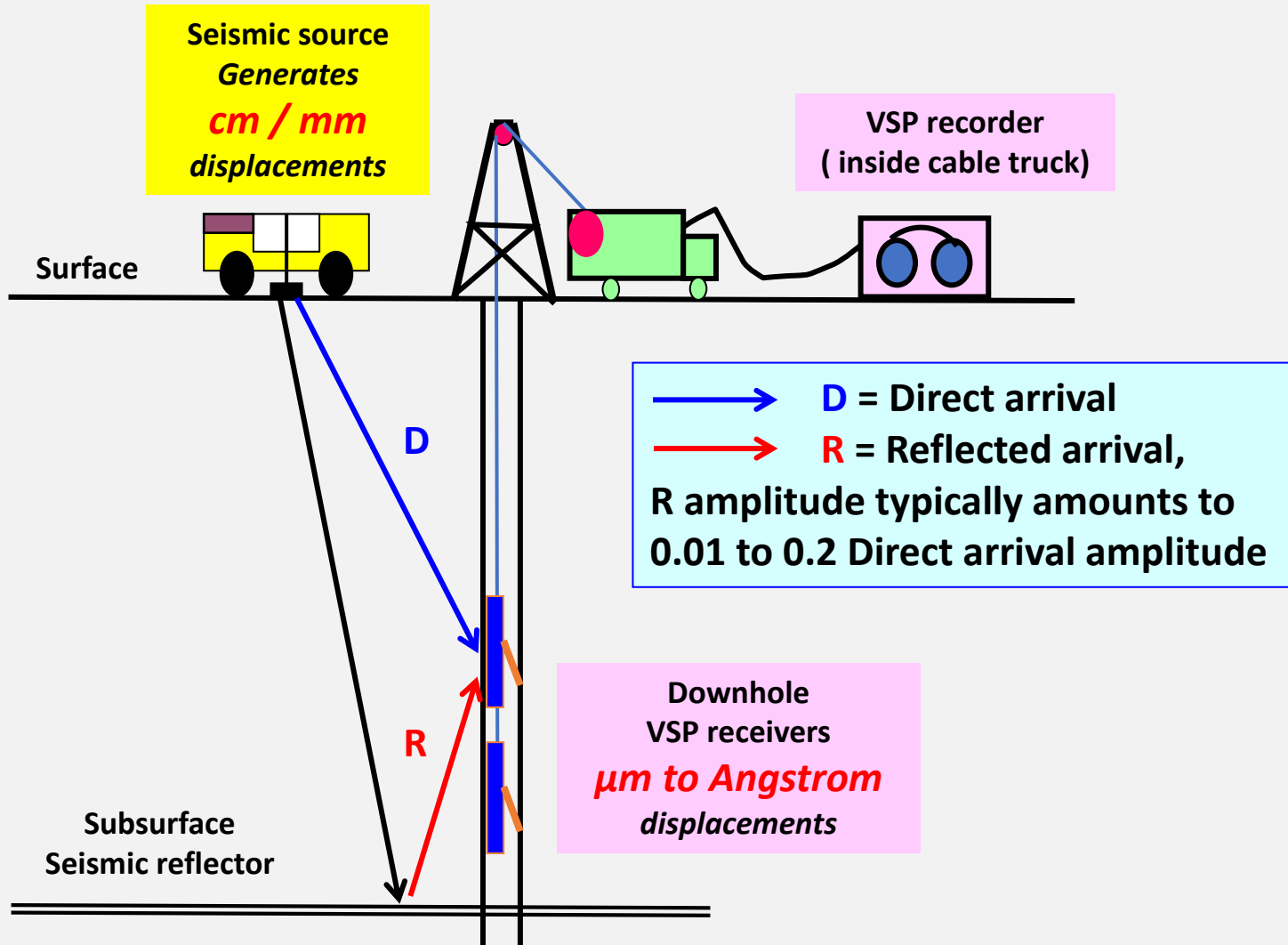
7- **IFPEN** : Charles Naville, Christine Souque: Geosciences, VSP acquisition coordination .

➤ Intermediate VSP operation on a GEOTHERMAL well drilled for:

SEER (Société d'Exploitation des Energies Renouvelables).



VSP - Vertical Seismic Profiling method - PRINCIPLE



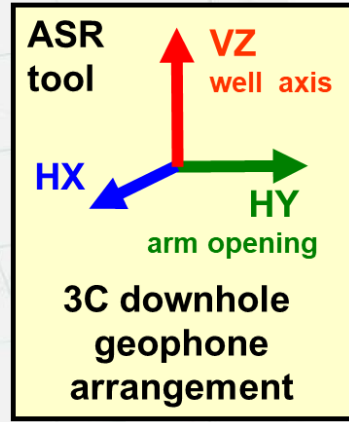
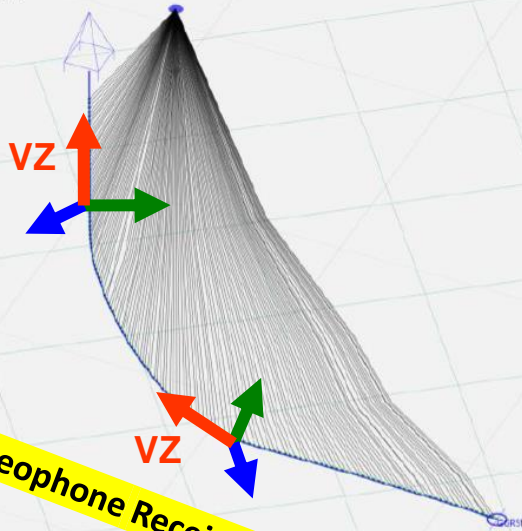
Ray tracing model built to check and optimise the VSP acquisition geometry, by AVALON/ASL, using VSPROWESS software

Direct P-arrival

PP reflections in reservoir

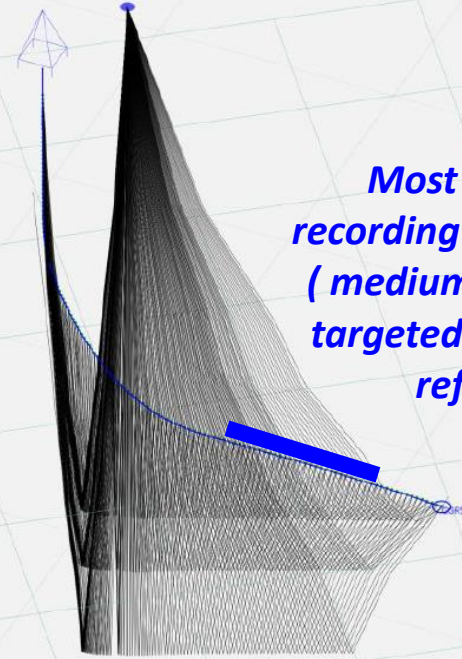
Dip: 38 degrees
Direction: 336 (-24) degrees
Grid: 700 m
Depth is below SDE (TVDSO)

Vibrator position, on GEE site



Dip: 38 degrees
Direction: 336 (-24) degrees
Grid: 700 m
Depth is below SDE (TVDSO)

Most promising recording depth interval (medium incidence on targeted intra-Dogger reflectors)



Receivers to Top Dogger

February 19th, 2023:

Field scouting & preparation

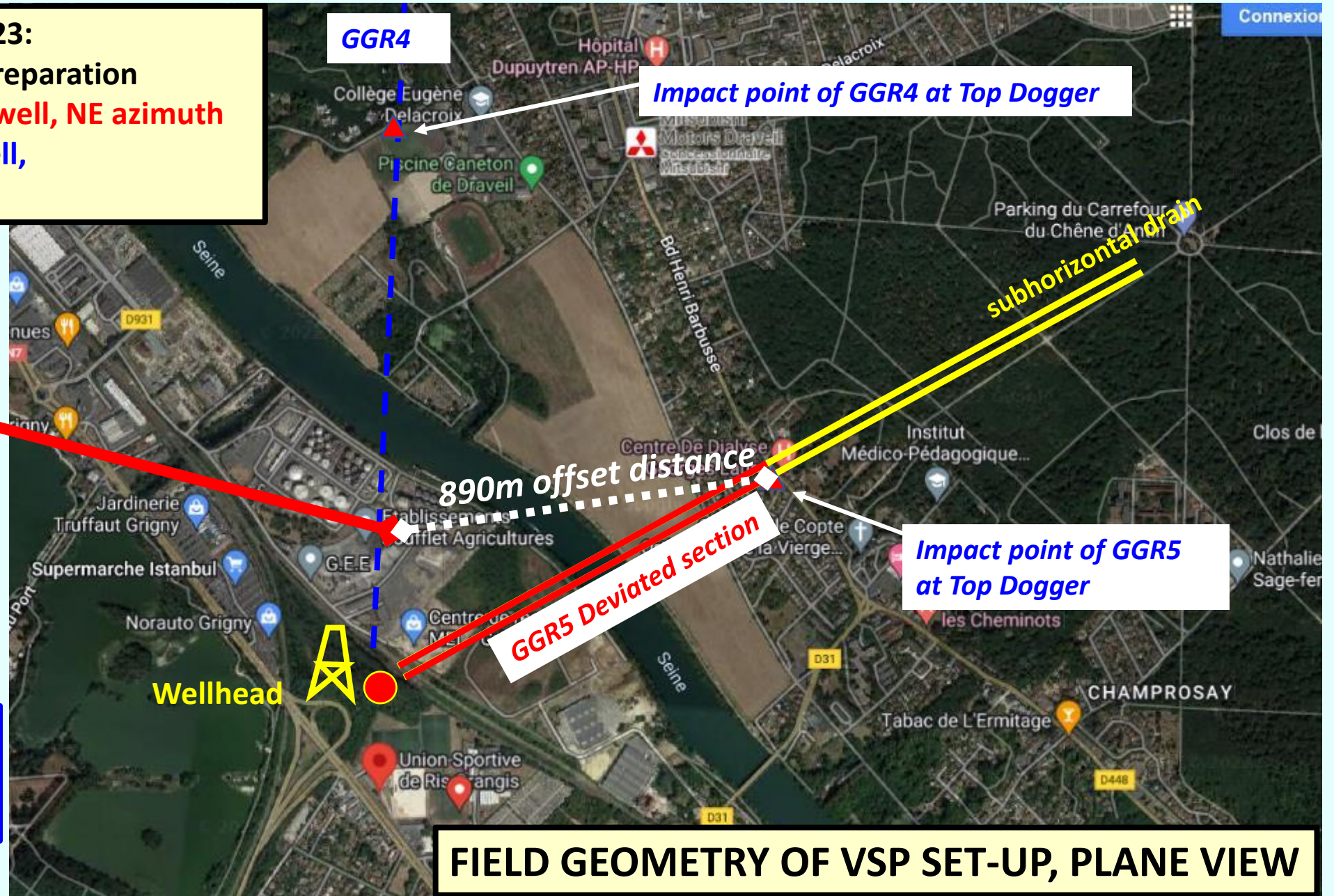
GGR5 production well, NE azimuth

GGR4 injection well,

Northern azimuth

**FIX Position for
vibrator truck
on hard ground
surface GEE site**

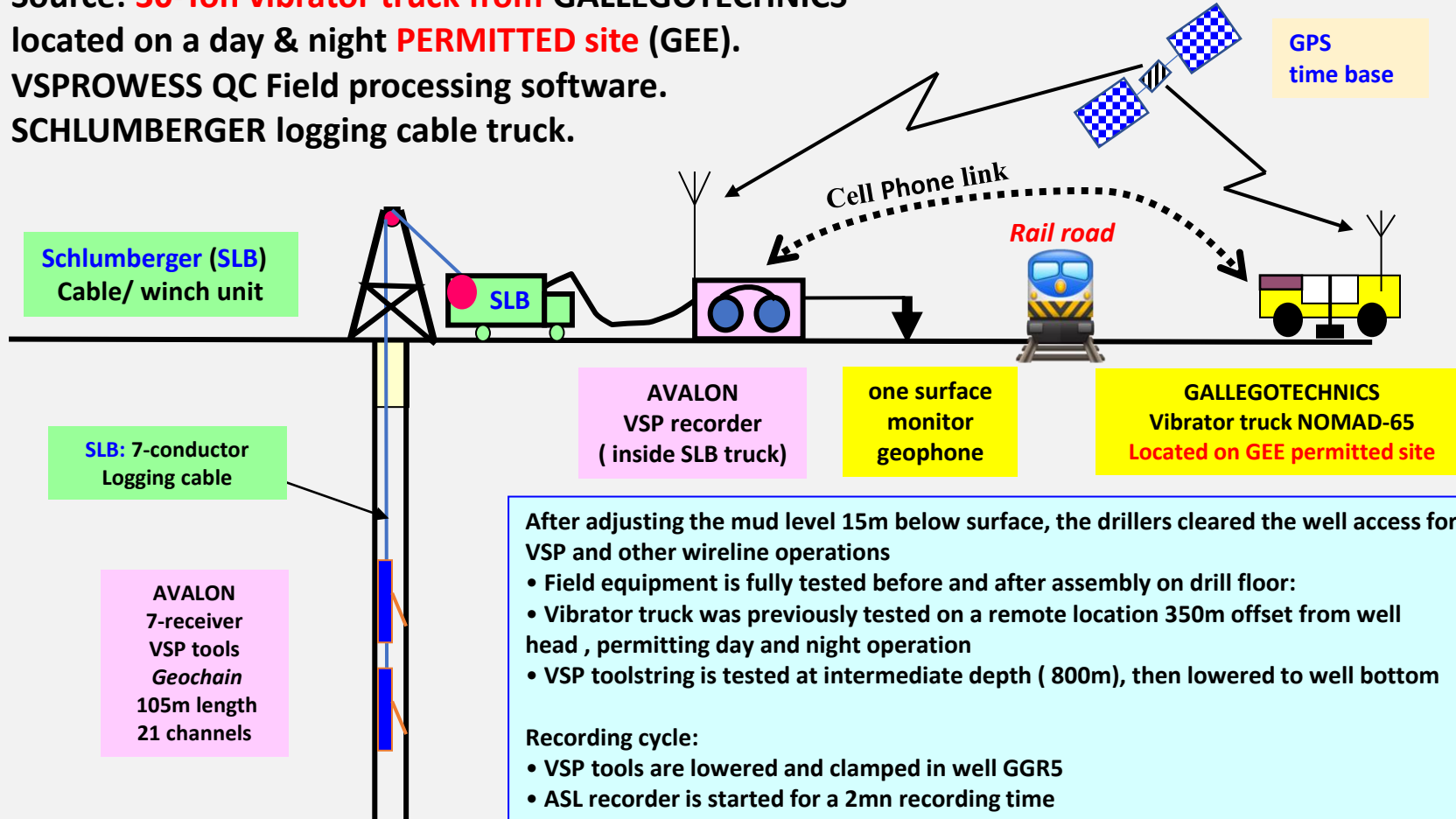
March 8th, 2023:
VSP operation
in GGR5



FIELD GEOMETRY OF VSP SET-UP, PLANE VIEW

GGR5 HF/HR VSP - FIELD EQUIPMENT

VSP recorded by a **Geochain downhole tool string** & recorder operated by ASL -AVALON,
 Source: **30-Ton vibrator truck from GALLEGOTECHNICS**
 located on a day & night **PERMITTED site** (GEE).
 VSPROWESS QC Field processing software.
 SCHLUMBERGER logging cable truck.



IFPEN : Technical coordination
 GEOFLUID: global organisation

After adjusting the mud level 15m below surface, the drillers cleared the well access for VSP and other wireline operations

- Field equipment is fully tested before and after assembly on drill floor:
- Vibrator truck was previously tested on a remote location 350m offset from well head , permitting day and night operation
- VSP toolstring is tested at intermediate depth (800m), then lowered to well bottom

Recording cycle:

- VSP tools are lowered and clamped in well GGR5
- ASL recorder is started for a 2mn recording time
- Vibrator is activated manually on oral phone request from ASL observer.
 A series of 4 sweeps, 25s each, in ZERO Slip time mode, is emitted by the vibrator.
- VSP tools are unlocked and moved up in GGR5 well.

- Single VSP run , 7.5m depth increment right above Dogger target, 15m otherwise



The downhole receiver toolstring is fully checked and re-tested on surface.

VSP recording chain in a glance



Powerful Nomad 65 vibrator
30 tons, Sweep 5-175 Hz



Real Time recording QC



View from the inside of the Schlumberger cabin





GRIGNY VSP, Source Vibrator NOMAD 65



**Vibrator SERCEL NOMAD 65.
Adjusting emission parameters.**

Short videos of NOMAD 65 vibrator in action: [\(Ctrl-Click\)](#)

a) [Looking for a fix position of VSP source](#)

b) [Sweep emission Log7 \(5-175Hz\)](#)

Pump-up the sound to hear the sweep

- Vibrator Nomad 65:
- Electronic control system DSD VE464 unit
- GPS Trimble DSM 232
- HP Laptop computer with VLI software



Figure 2: Photos of DSD VE 464

Very heavy rain showers occurred during VSP acquisition, which can soften the ground.

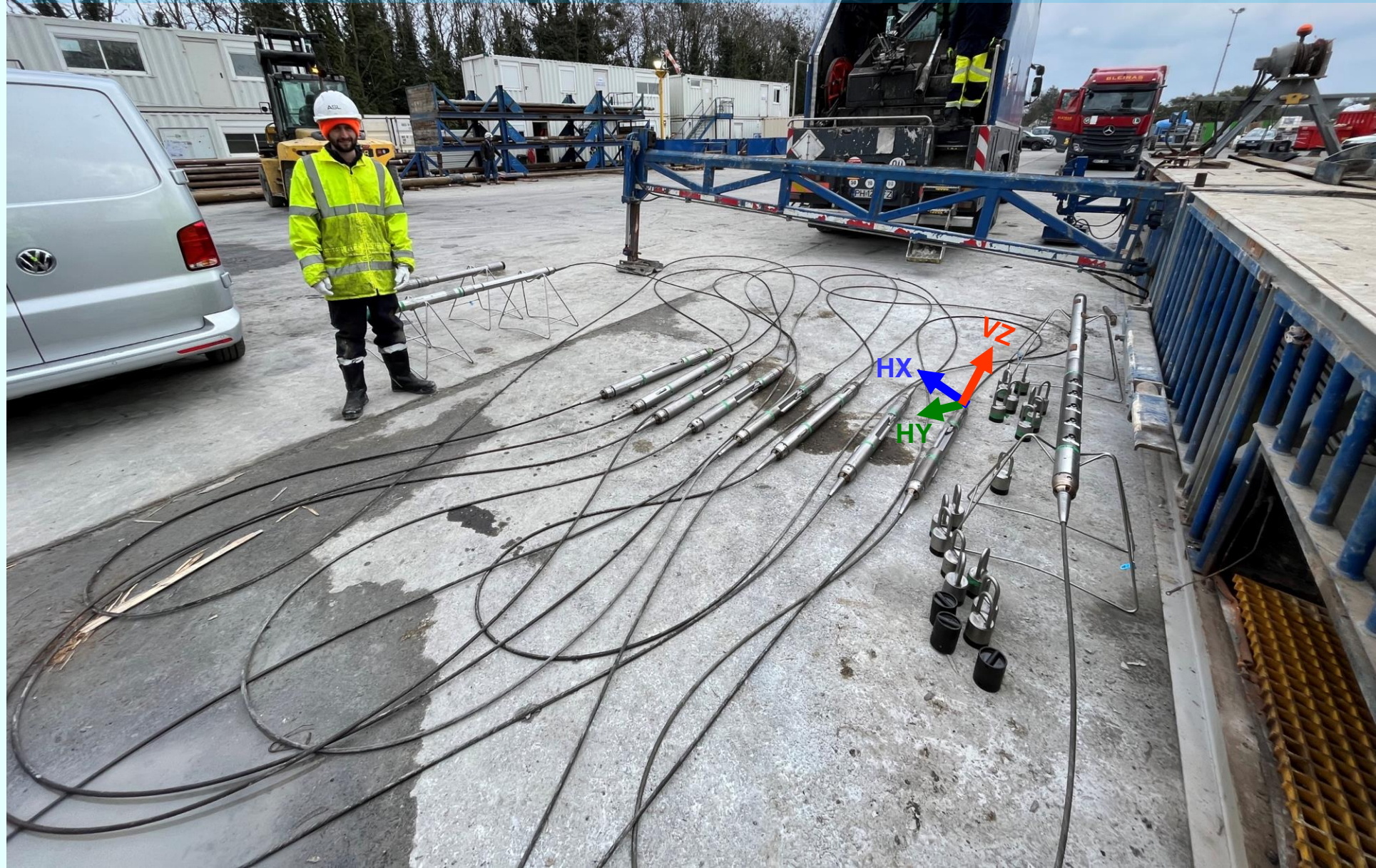


Positioning the vibrator on a hard top terrain prevents the vibrator baseplate from sinking progressively into the ground during the numerous emissions of a VSP acquisition.

Final tests of the GTG vibrator truck, synchronised with the ASL recorder through GPS time base.



The 7 level VSP GEOCHAIN toolstring of ASL (~105 m long) is fully tested on ground surface.





The 7 level VSP GEOCHAIN toolstring (105 m long) is assembled on the drillfloor before lowering into the borehole



VSP chain Testing/recording



Real Time control of VSP acquisition



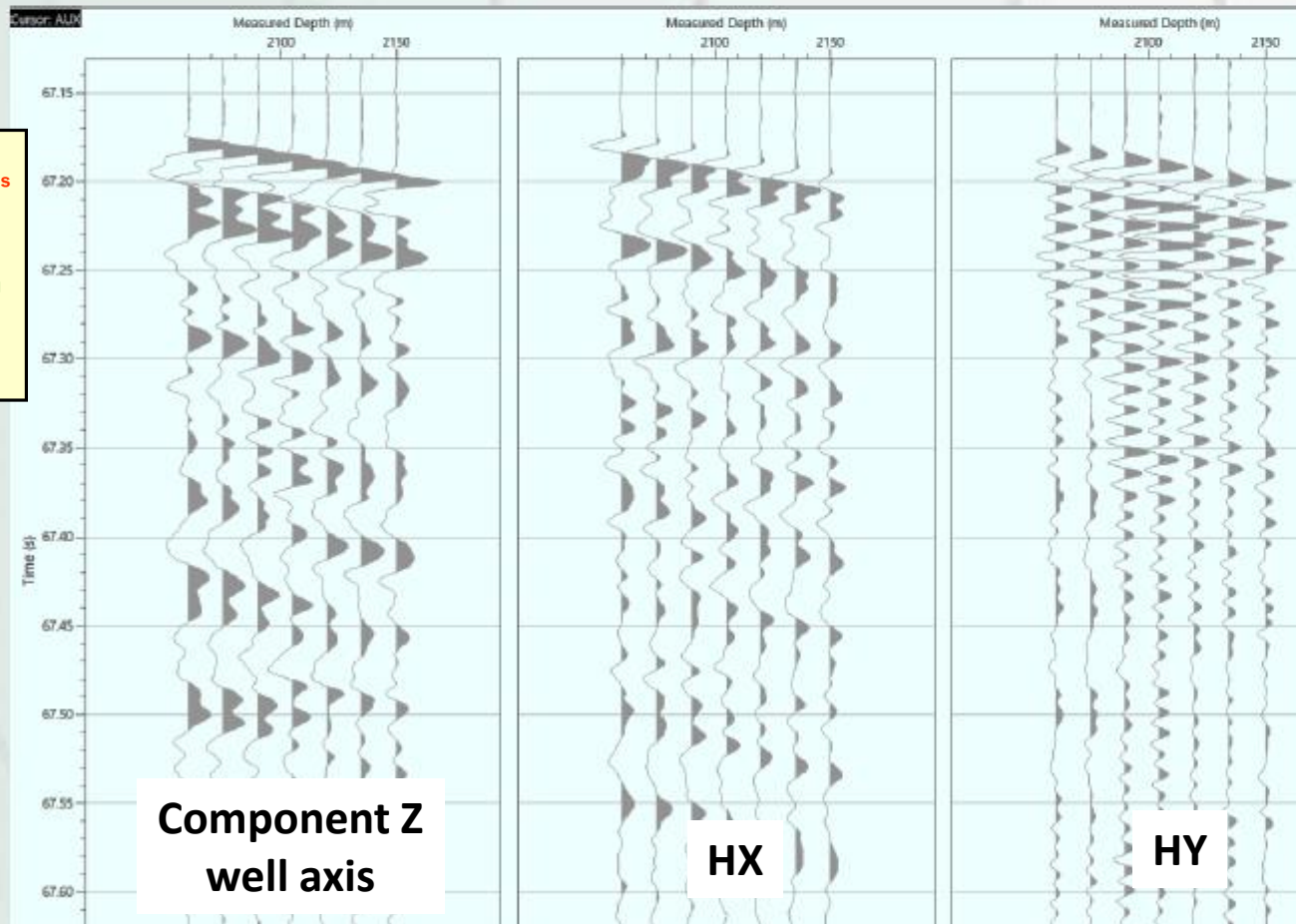
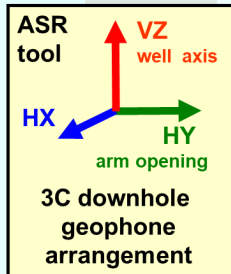
Deepest setting 2150m

ASL

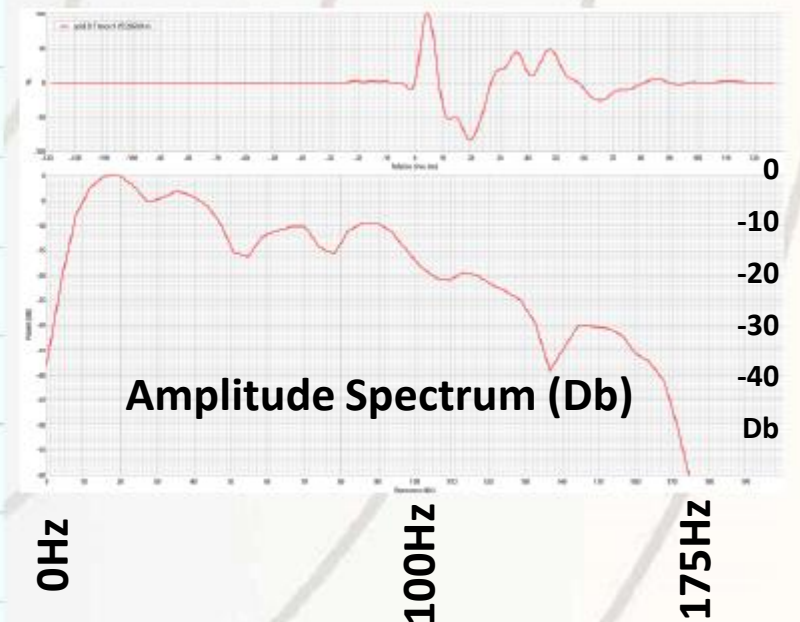
Avalon Sciences Ltd

LEADERS IN BOREHOLE SEISMIC TECHNOLOGY

Quality Control: Correct behavior of the whole recording chain,
7 level GEOCHAIN toolstring
at well bottom.



Bottom hole Z signal

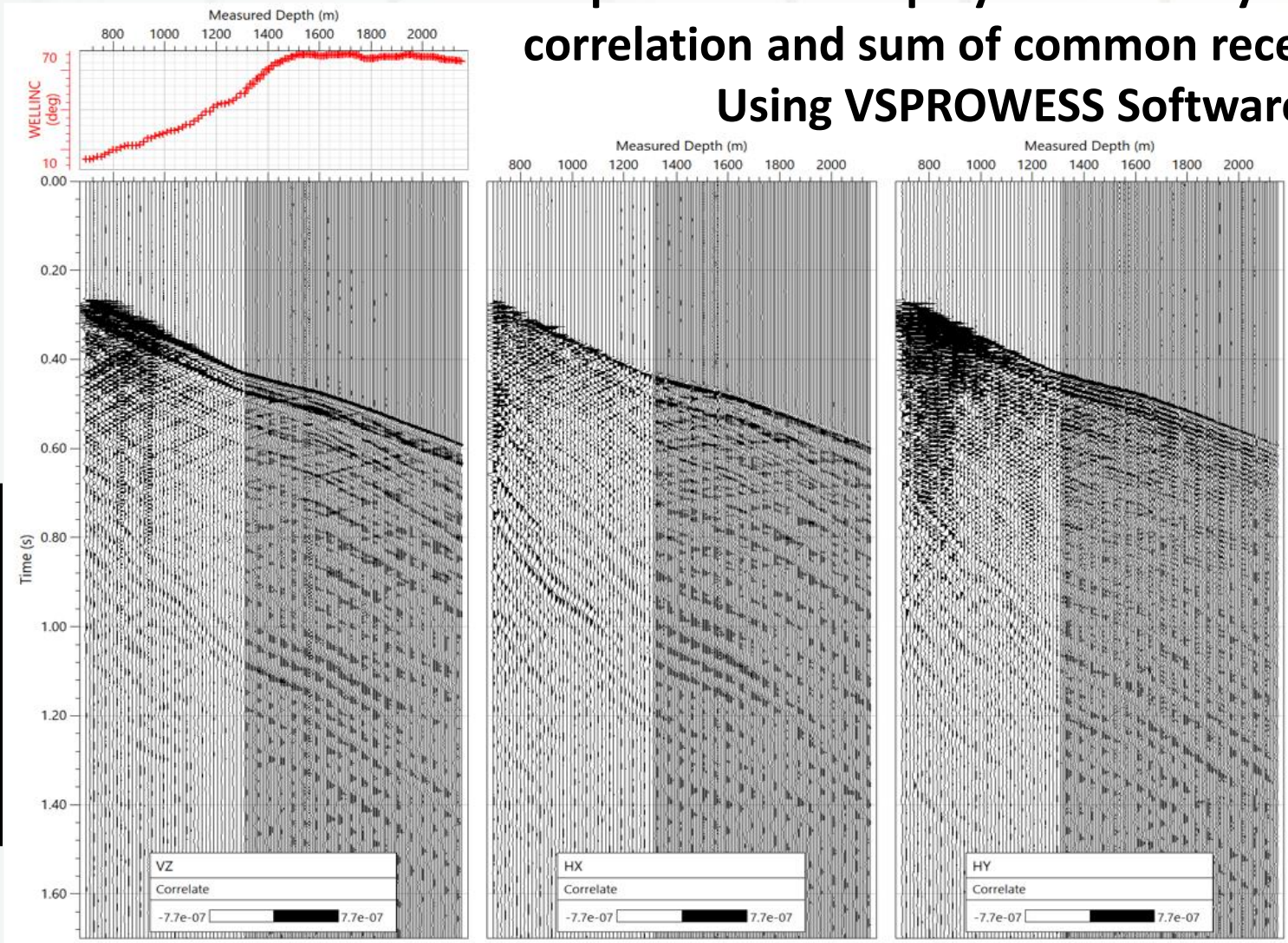
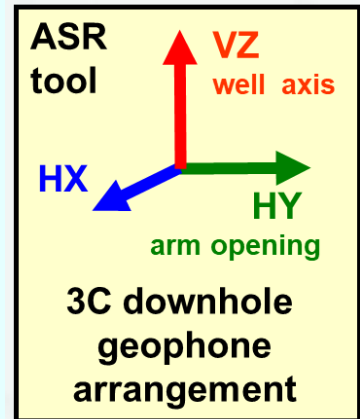


ASL et IFPEN field engineers validate the smooth, optimised and fast VSP operation, in spite of diverse random events: recording chain to be tweaked, heavy rain, etc.



3 component VSP display after GPS synchronisation,
correlation and sum of common receiver data.

Using VSPROWESS Software

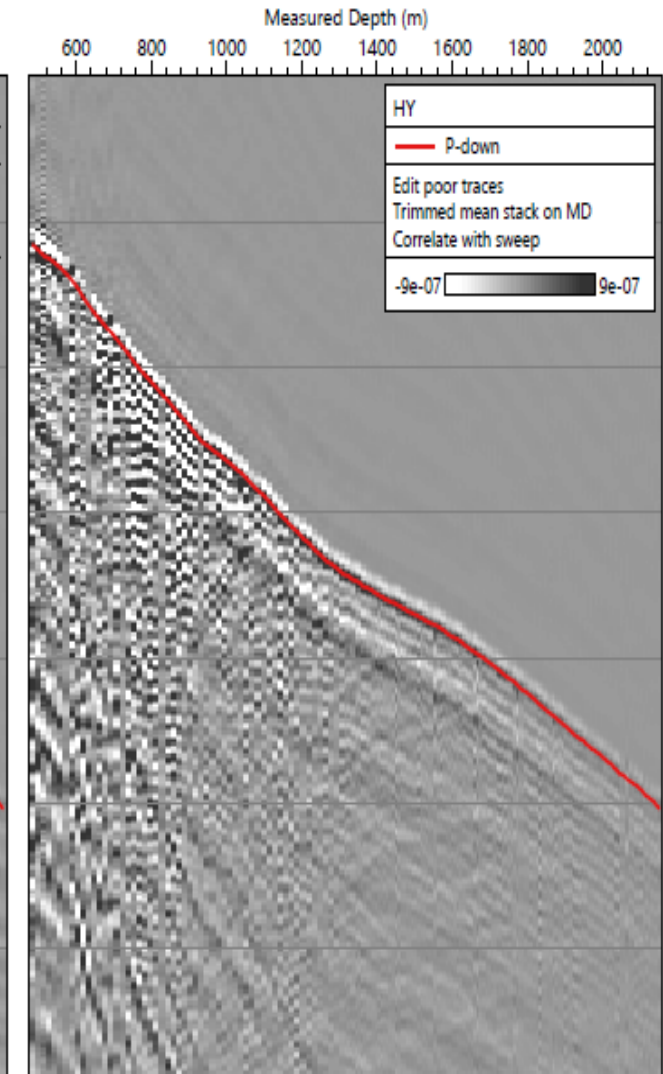
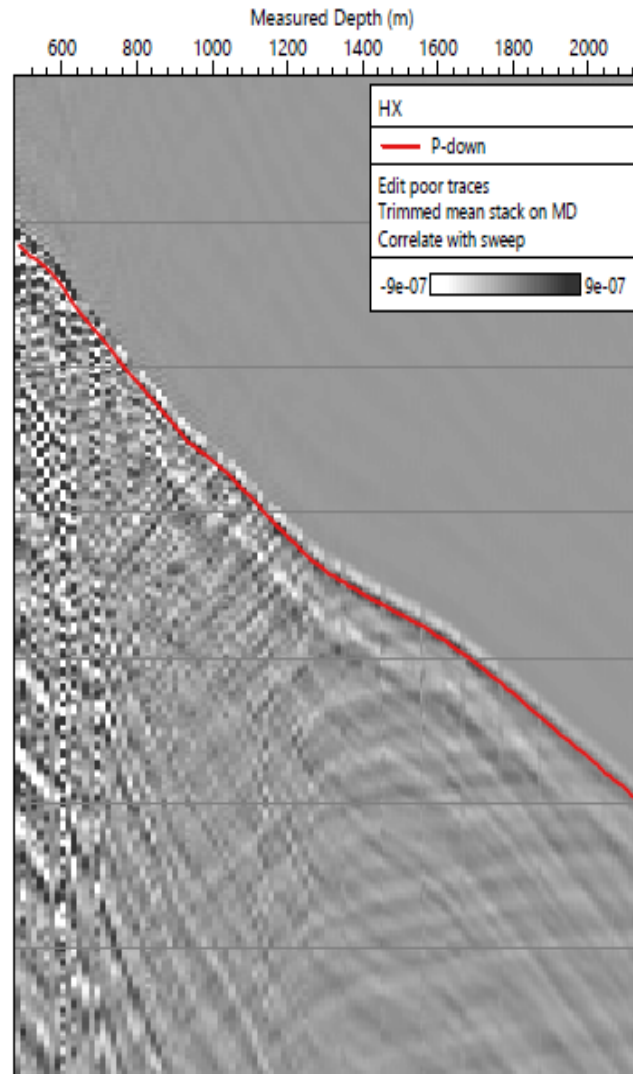
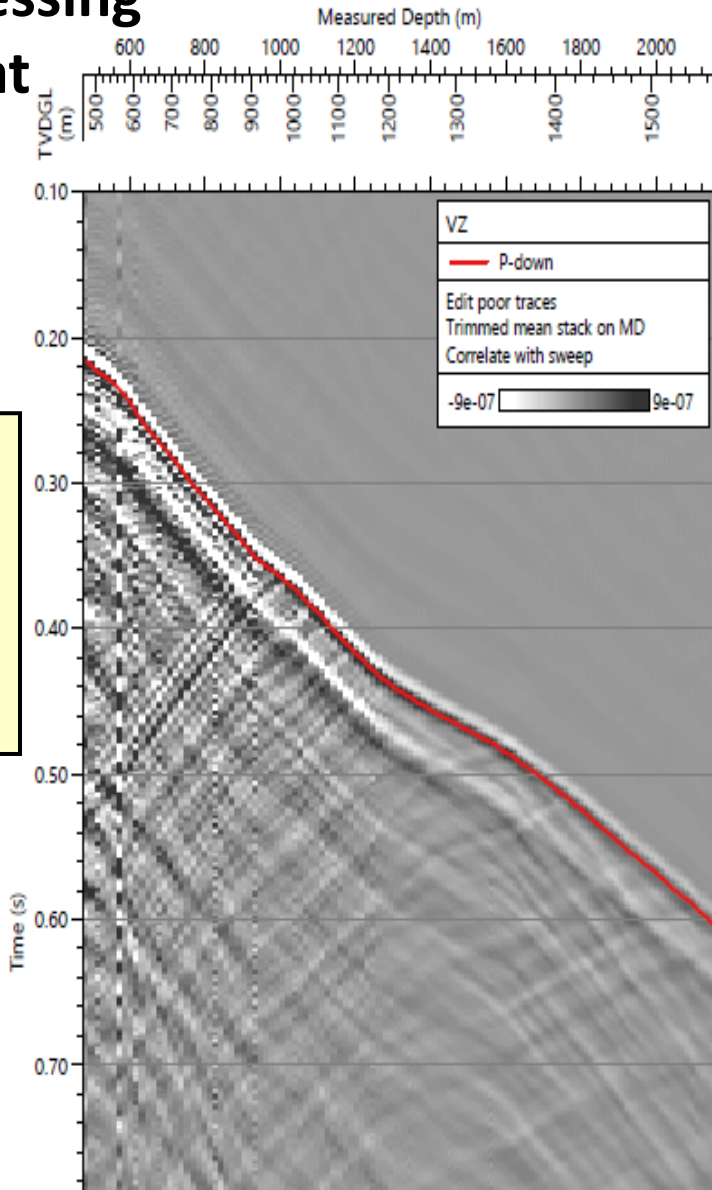
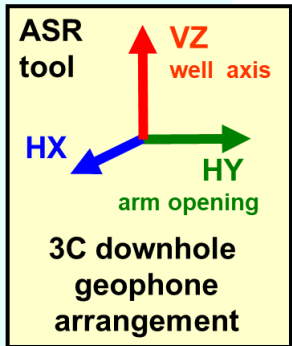


Cross normalized

Preprocessing
refined at
office

Figure 2.5.2 Stacked 3C data

3 component VSP display after GPS synchronisation,
correlation and sum of common receiver data.



The GPS synchronisation of the vibrator source and the borehole GEOCHAIN sensors was executed by VSPROWESS

Thanks to all for your collaboration

SEER- Grigny



GEE

Illustrations
ASL - IFPEN

