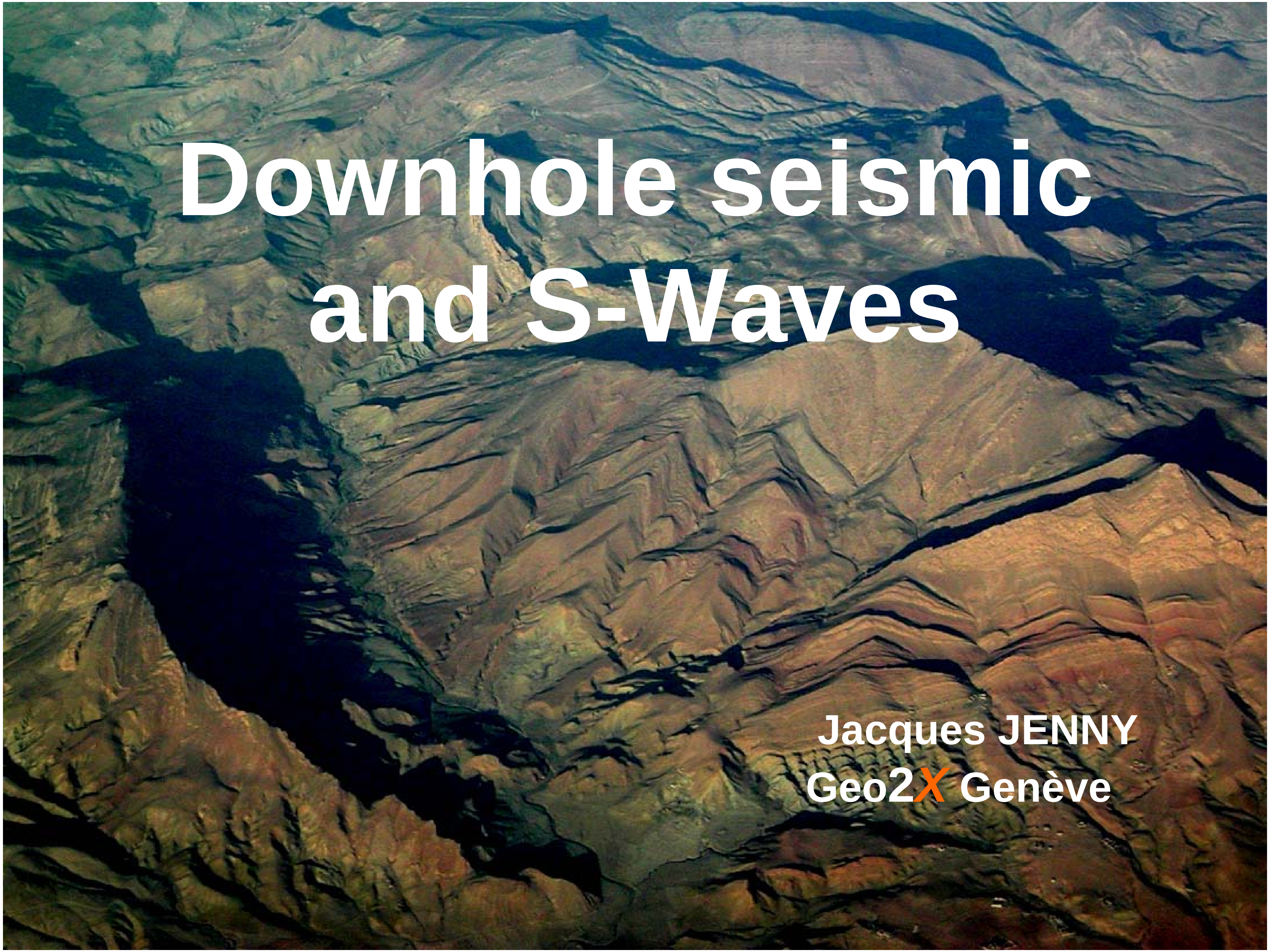

Downhole seismic and S-Waves

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Geo2X Genève

Principles

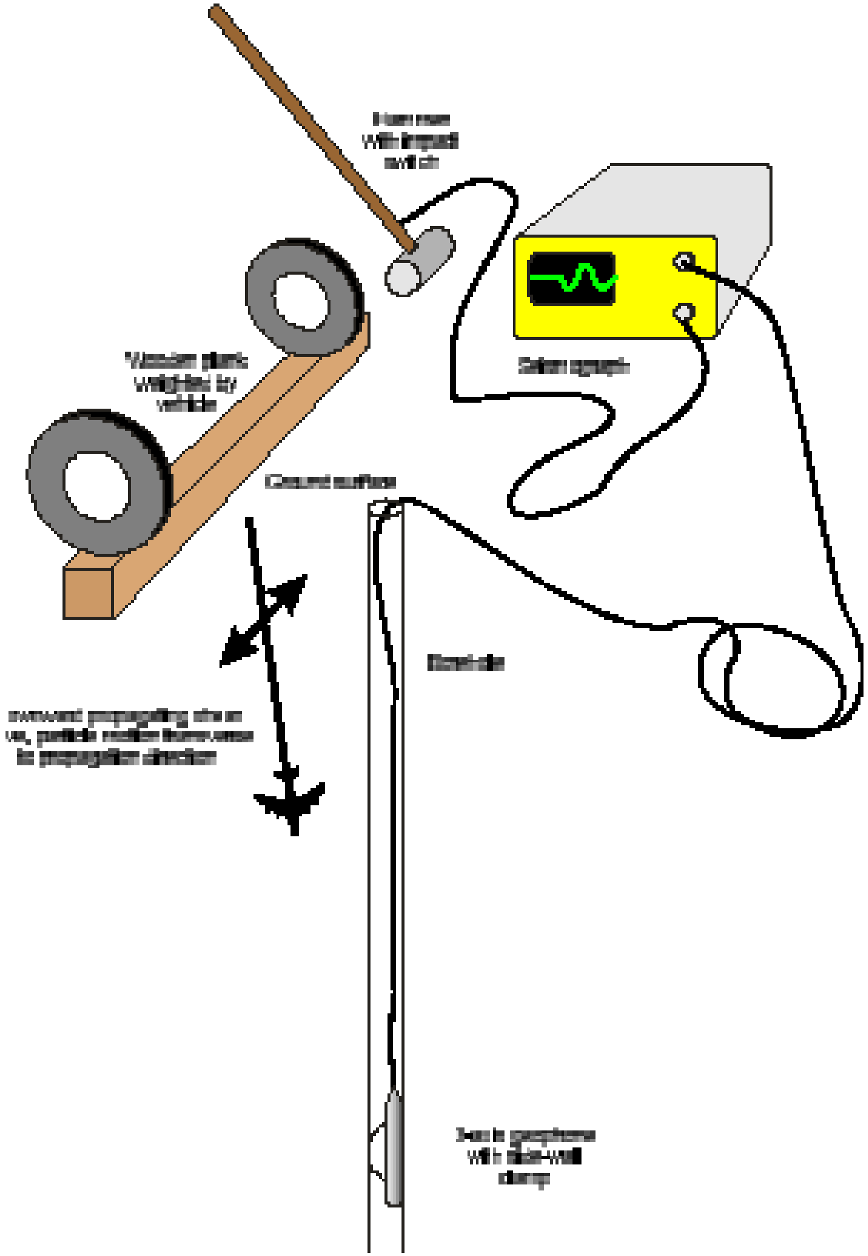
A triaxial geophone is moved down into a borehole connected with a seismograph

Regularly, the geophones are jammed into the hole

On the ground surface, P and S wave are generated usually with a sledge hammer hiting a beam

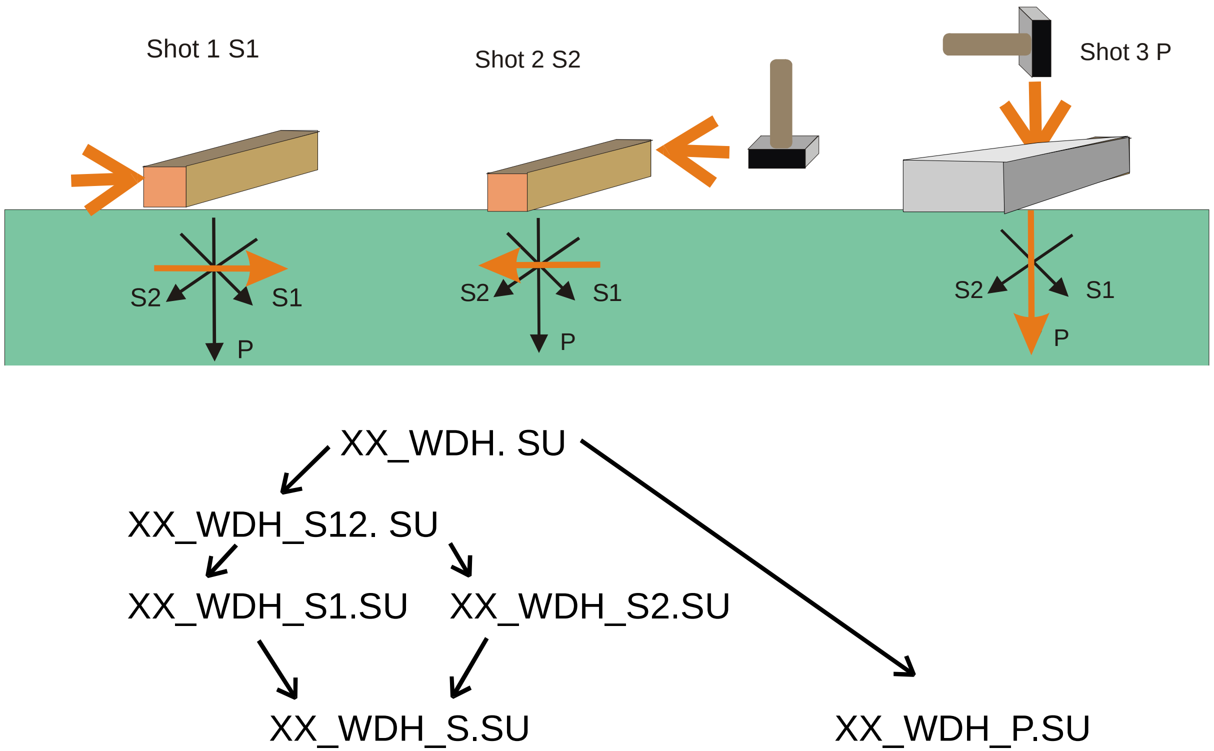
Principles

P waves are done hitting vertically an aluminium plate on the ground



To create S waves we can strike a piece of wood firmly blocked (below cars tire for example)

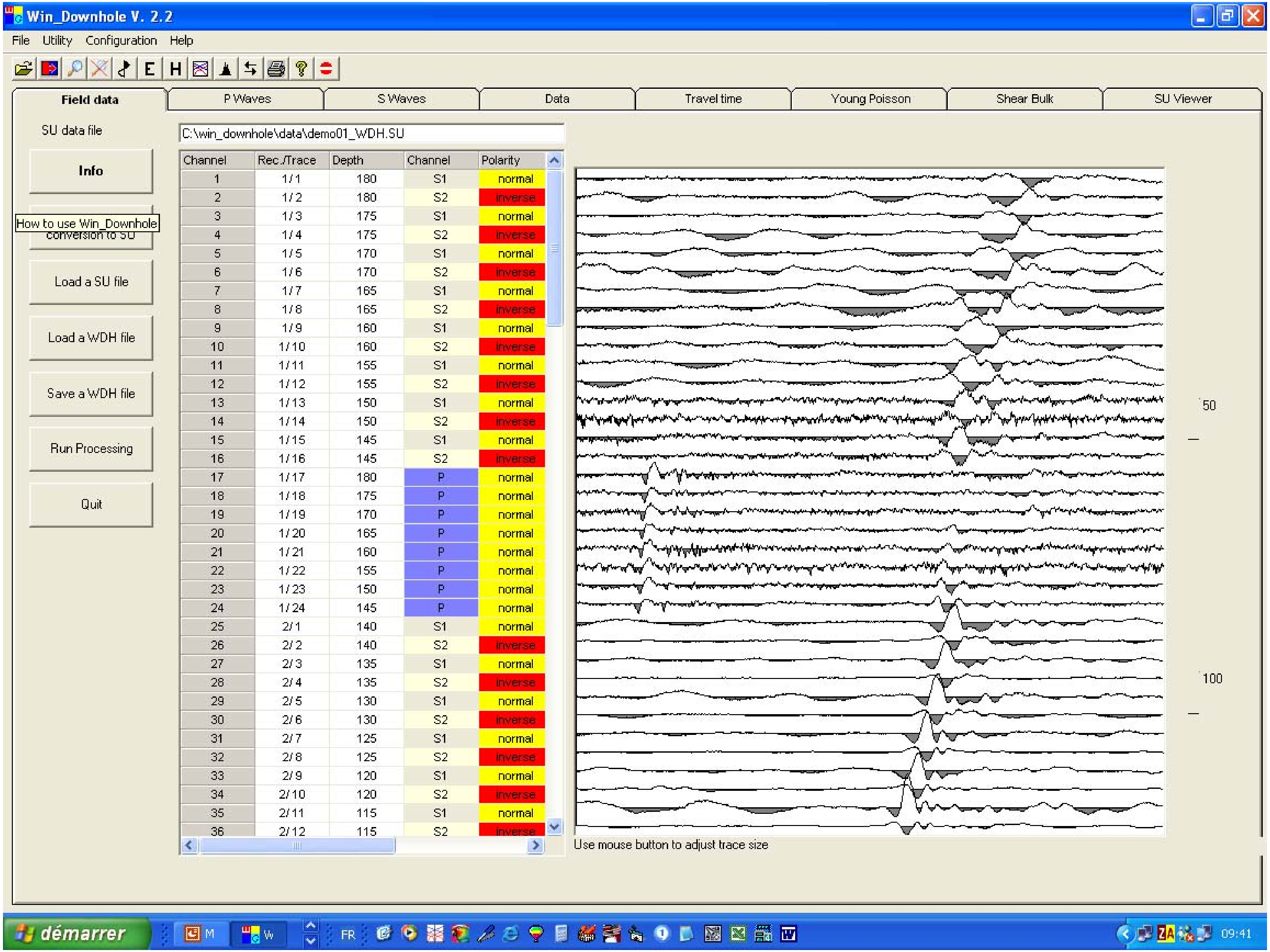
Principles



Shot 1 S1
Shot 2 S2
Shot 3 P
S2
S1
P
S2
S1
P
S2
S1
P
XX_WDH. SU
XX_WDH_S12. SU
XX_WDH_S1.SU
XX_WDH_S2.SU
XX_WDH_S.SU
XX_WDH_P.SU

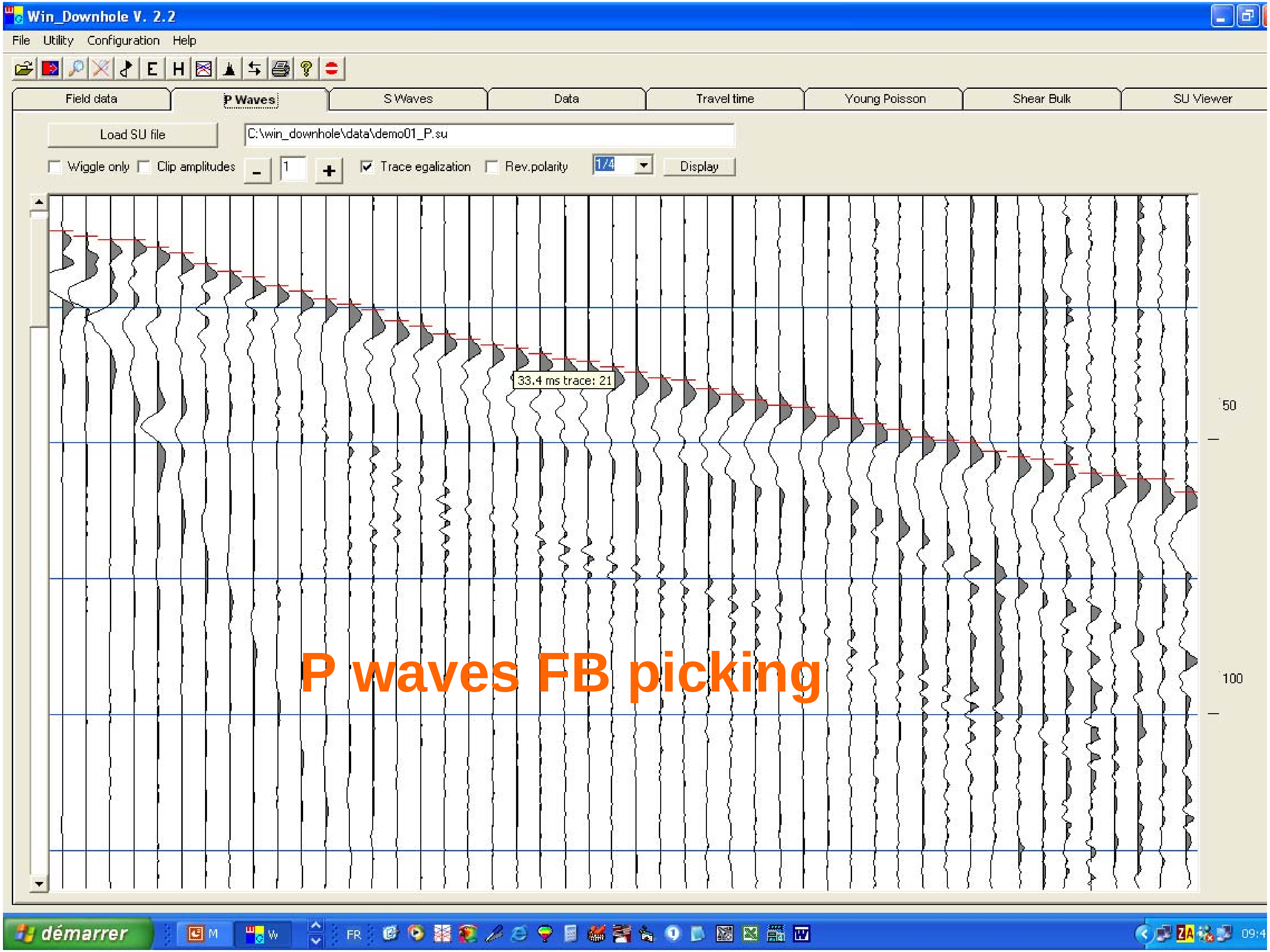
Processing data using
Win_Downhole

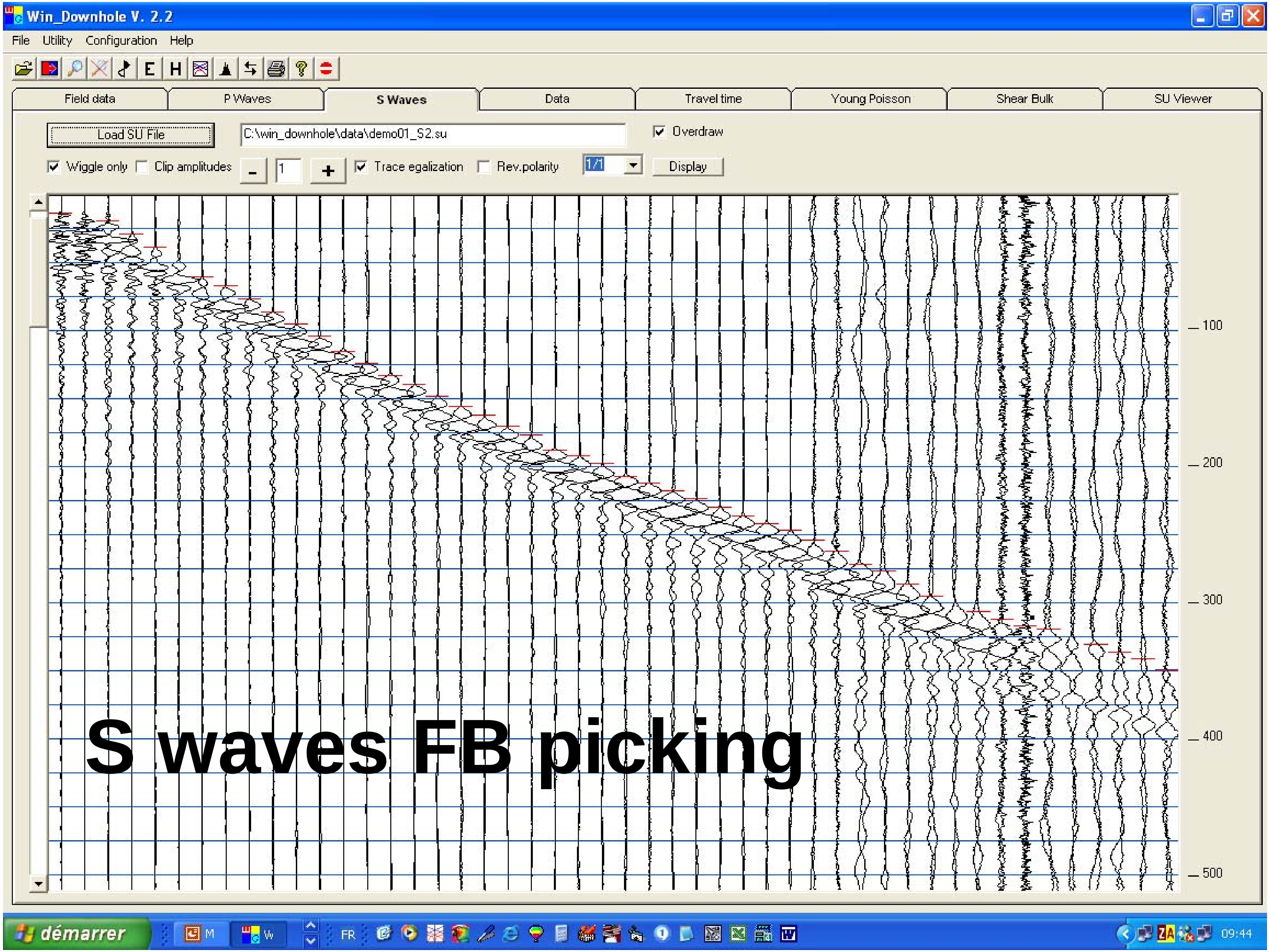
1. Conversion to SU format
2. Depth and type (P,S1,S2) input for all traces
3. Extraction of P, S1, S2 traces
4. Addition of S1 + S2 after polarity inversion
5. FBP picking on P and S traces
6. Velocity / Depth diagram
7. Modulus computation



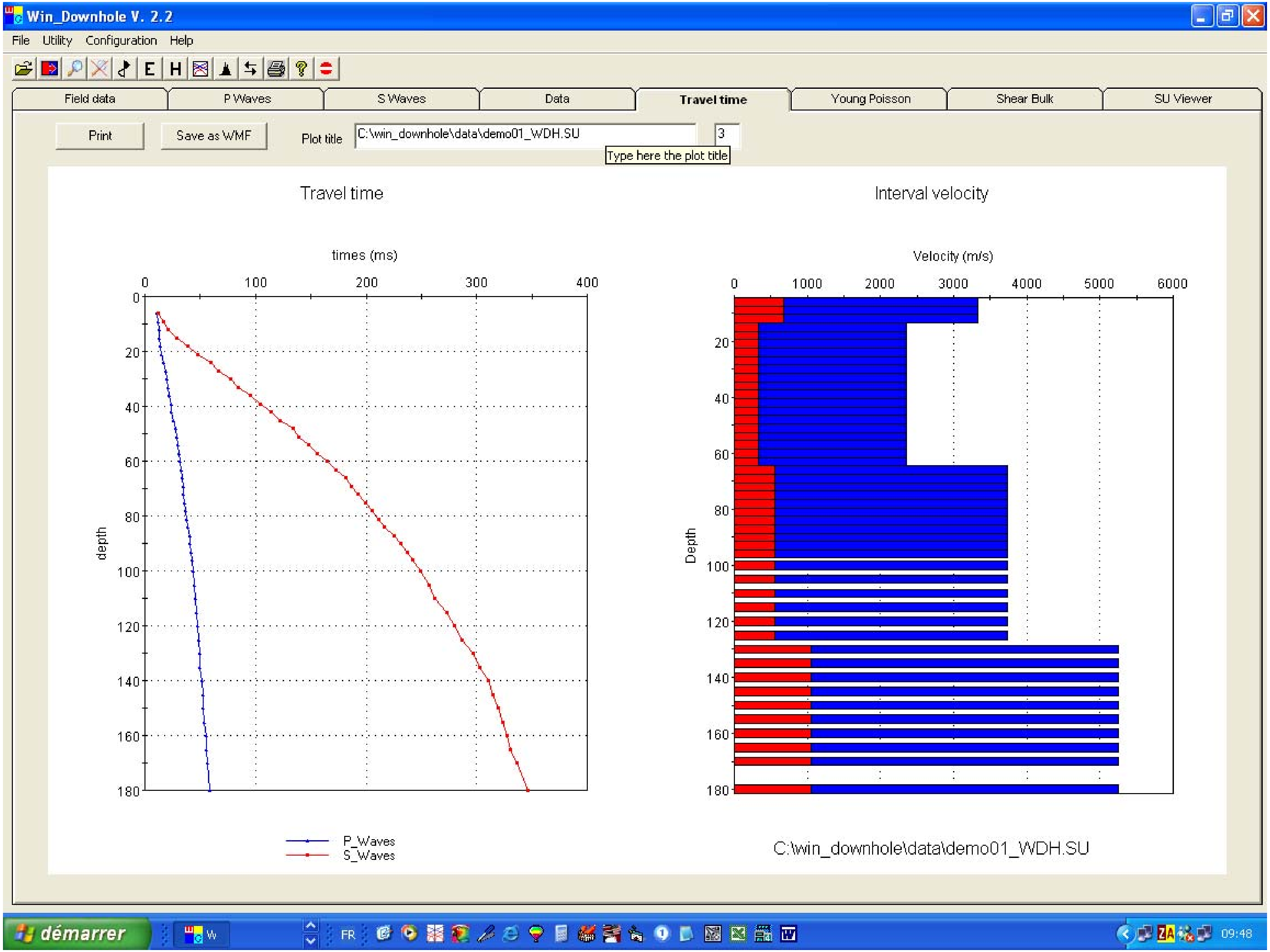
Channel	Rec./Trace	Depth	Channel	Polarity
1	1/1	180	S1	normal
2	1/2	180	S2	inverse
3	1/3	175	S1	normal
4	1/4	175	S2	inverse
5	1/5	170	S1	normal
6	1/6	170	S2	inverse
7	1/7	165	S1	normal
8	1/8	165	S2	inverse
9	1/9	160	S1	normal
10	1/10	160	S2	inverse
11	1/11	155	S1	normal
12	1/12	155	S2	inverse
13	1/13	150	S1	normal
14	1/14	150	S2	inverse
15	1/15	145	S1	normal
16	1/16	145	S2	inverse
17	1/17	180	P	normal
18	1/18	175	P	normal
19	1/19	170	P	normal
20	1/20	165	P	normal
21	1/21	160	P	normal
22	1/22	155	P	normal
23	1/23	150	P	normal
24	1/24	145	P	normal
25	2/1	140	S1	normal
26	2/2	140	S2	inverse
27	2/3	135	S1	normal
28	2/4	135	S2	inverse
29	2/5	130	S1	normal
30	2/6	130	S2	inverse
31	2/7	125	S1	normal
32	2/8	125	S2	inverse
33	2/9	120	S1	normal
34	2/10	120	S2	inverse
35	2/11	115	S1	normal
36	2/12	115	S2	inverse

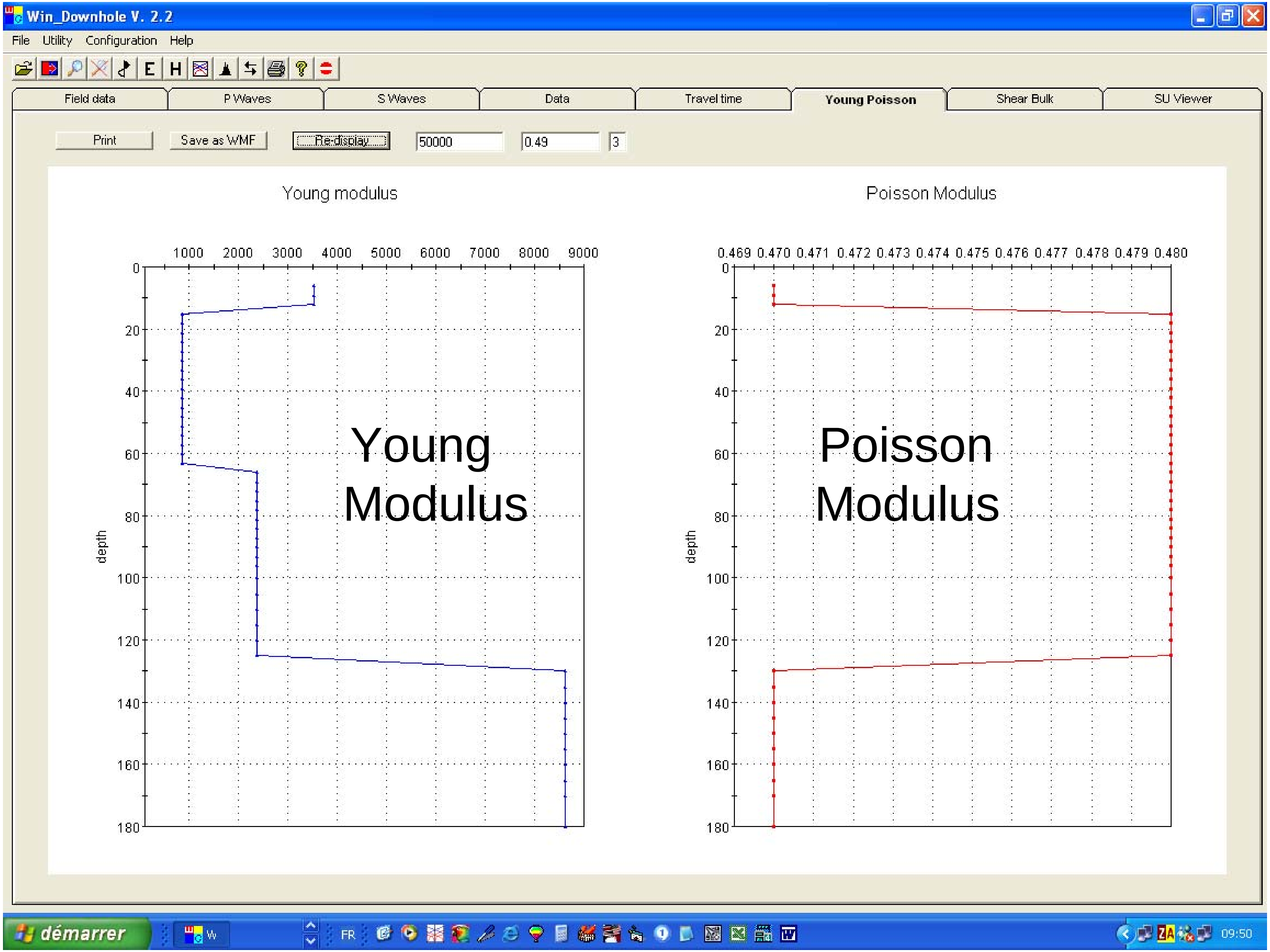
P waves FB picking





S waves FB picking


Win_Downhole V. 2.2
File Utility Configuration Help
Field data
P Waves
S Waves
Data
Travel time
Young Poisson
Shear Bulk
SU Viewer
Print
Save as WMF
Plot title
C:\win_downhole\data\demo01_WDH.SU
3
Type here the plot title
Travel time
times (ms)
0 100 200 300 400
depth
0 20 40 60 80 100 120 140 160 180
P_Waves
S_Waves
Interval velocity
Velocity (m/s)
0 1000 2000 3000 4000 5000 6000
Depth
20 40 60 80 100 120 140 160 180
C:\win_downhole\data\demo01_WDH.SU
démarrer
FR
09:48



Win_Downhole V. 2.2
File Utility Configuration Help
Field data
P Waves
S Waves
Data
Travel time
Young Poisson
Shear Bulk
SU Viewer
Print
Save as WMF
Re-display
50000
0.49
3
Young modulus
Poisson Modulus
1000 2000 3000 4000 5000 6000 7000 8000 9000
0.469 0.470 0.471 0.472 0.473 0.474 0.475 0.476 0.477 0.478 0.479 0.480
0 20 40 60 80 100 120 140 160 180
depth
Young Modulus
Poisson Modulus
démarrer
FR
09:50

Formula

Poisson's Ratio	$\bullet_p =$	$\dfrac{(Vp/Vs)^2 - 2}{2(Vp/Vs)^2 - 2}$
Shear Modulus	$G=$	$d\ Vs^2$
Young's Modulus	$E=$	$2G\ (1+\bullet_p)$
Bulk Modulus	$K=$	$\dfrac{1}{3} \cdot \dfrac{E}{1-2\bullet_p}$

S-wave refraction

Seismic refraction (and reflection) using S waves is possible with few adaptations:

- Horizontal geophones
- Energy with S component (Sledge hammer hiting laterally a beam, leaning buffalo gun shots.
- Two lateral shots added after polarity inversion to enhance S waves

Surface waves

The multichannel analysis of surface waves (MASW) method was first introduced into geotechnical and geophysical community in early 1999.

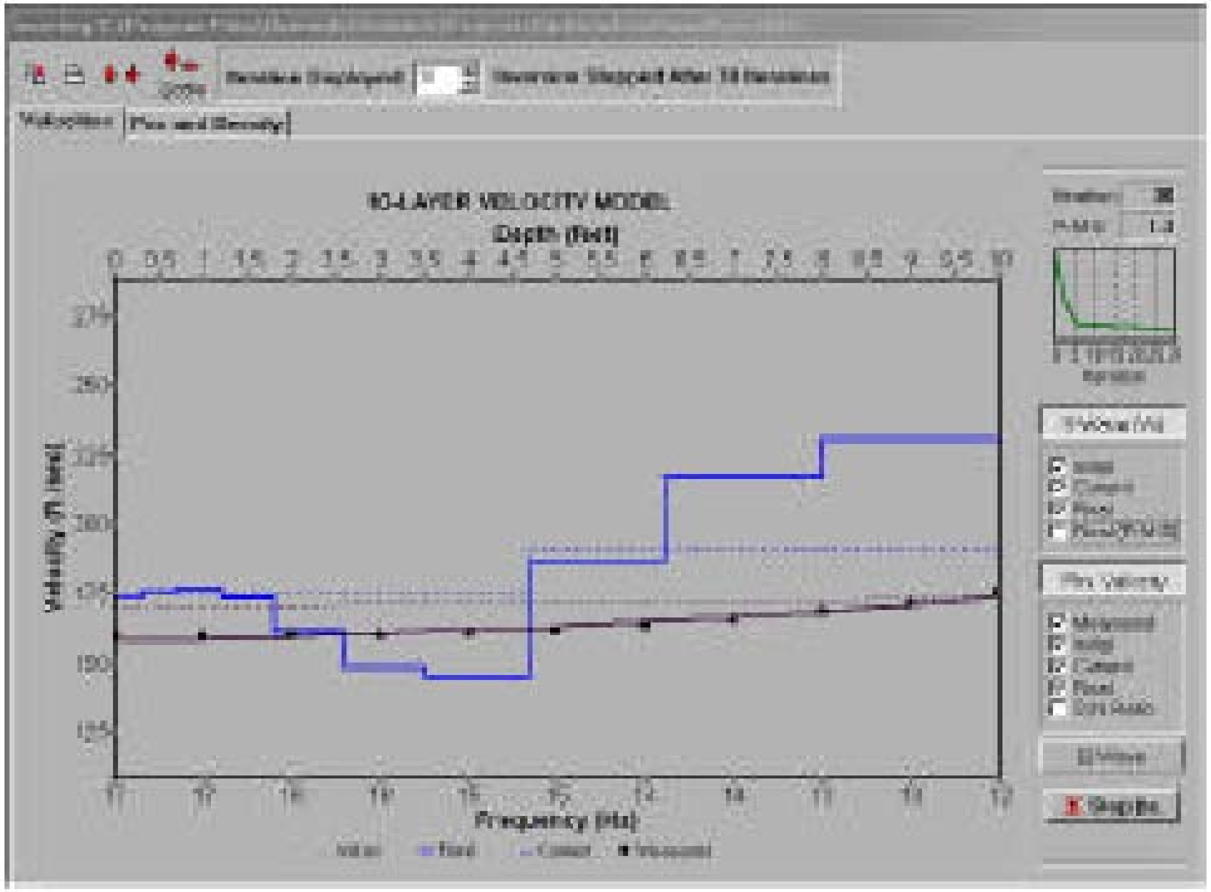
MASW is a seismic method which generates a shearwave velocity (Vs) profile (i.e., Vs versus depth) by analyzing Rayleigh-type surface waves on a multichannel record. The method utilizes multichannel recording. MASW utilizes energy commonly considered noise on conventional reflection seismic surveys.

Data acquisition

MASV requires

- 24 - 48 receivers
- Digital seismograph
- Low frequency geophones (4.5 Hz)
- Software

Final profile: Depth /Velocity




FIN END