

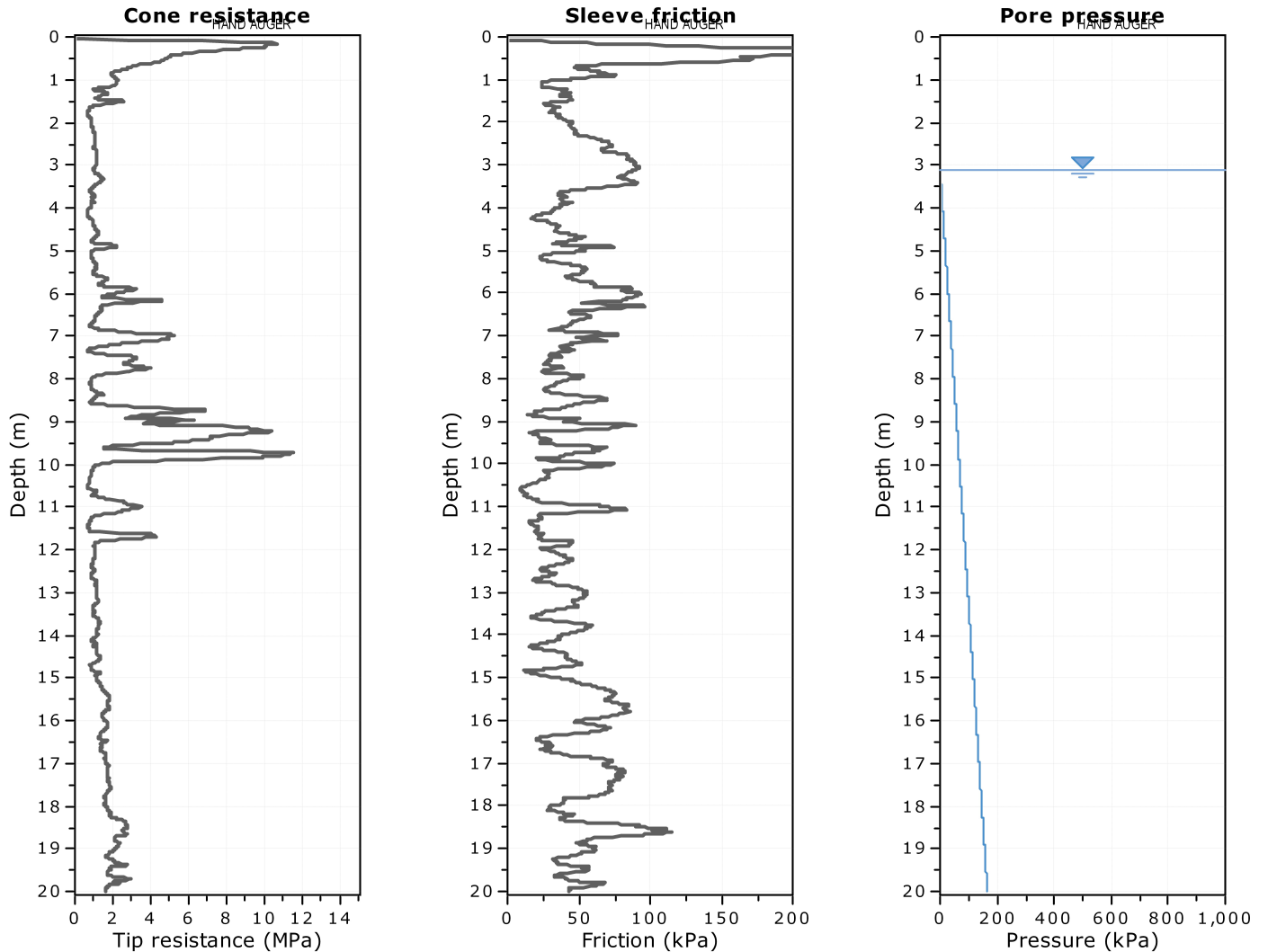
ALLEGATO N. 1

Prove geognostiche/geofisiche di nuova realizzazione



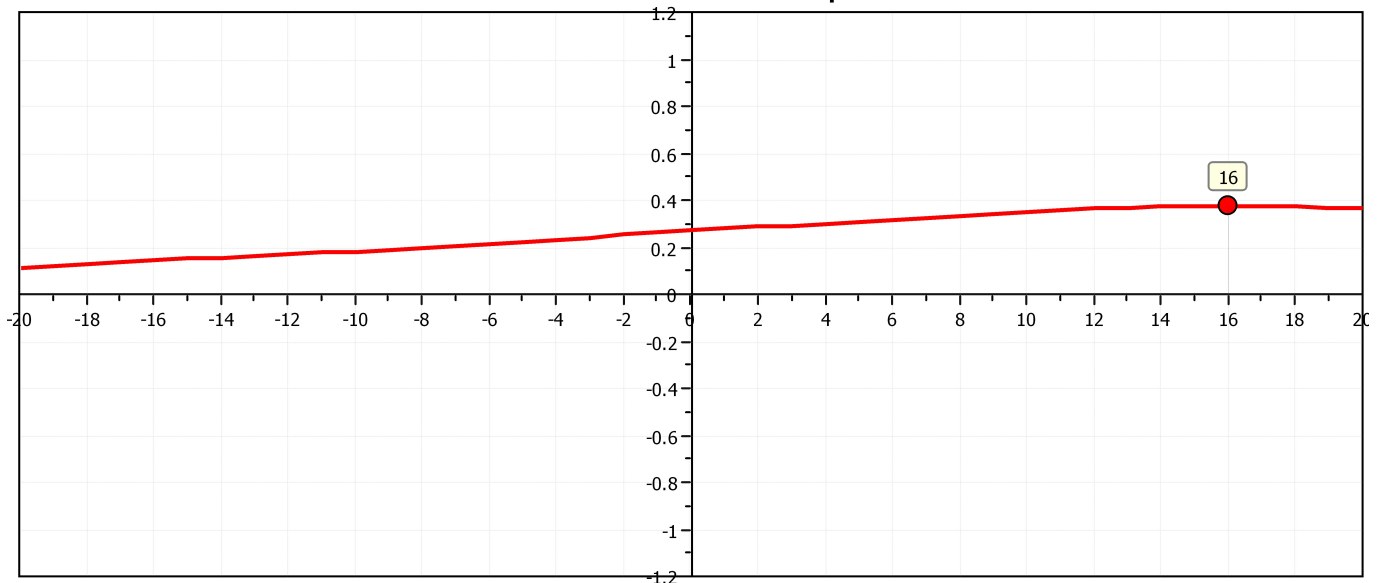
Project: Comune Gambettola (FC)

Location: Microzonazione sismica III livello



The plot below presents the cross correlation coefficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two successive CPT measurements).

Cross correlation between qc & fs





Project: Comune Gambettola (FC)

Location: Microzonazione sismica III livello

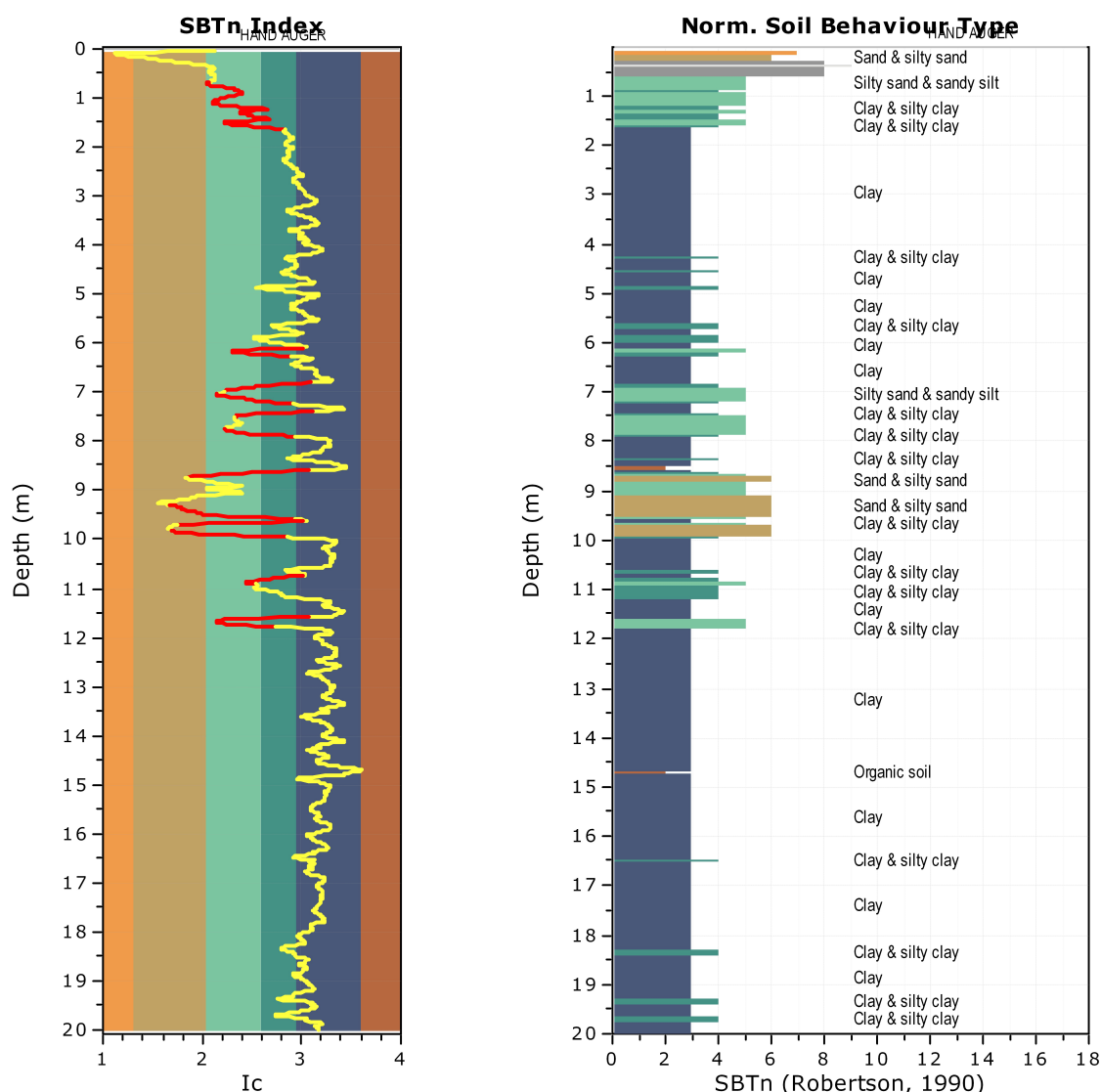
TRANSITION LAYER DETECTION ALGORITHM REPORT

Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vice-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between $1.80 < I_c < 3.0$) and a rate of change of I_c . Transitions typically occur when the rate of change of I_c is fast (i.e. ΔI_c is small).

The SBT_n plot below, displays in red the detected transition layers based on the parameters listed below the graphs.



Transition layer algorithm properties

I_c minimum check value: 1.70
 I_c maximum check value: 3.00
 I_c change ratio value: 0.0010
Minimum number of points in layer: 4

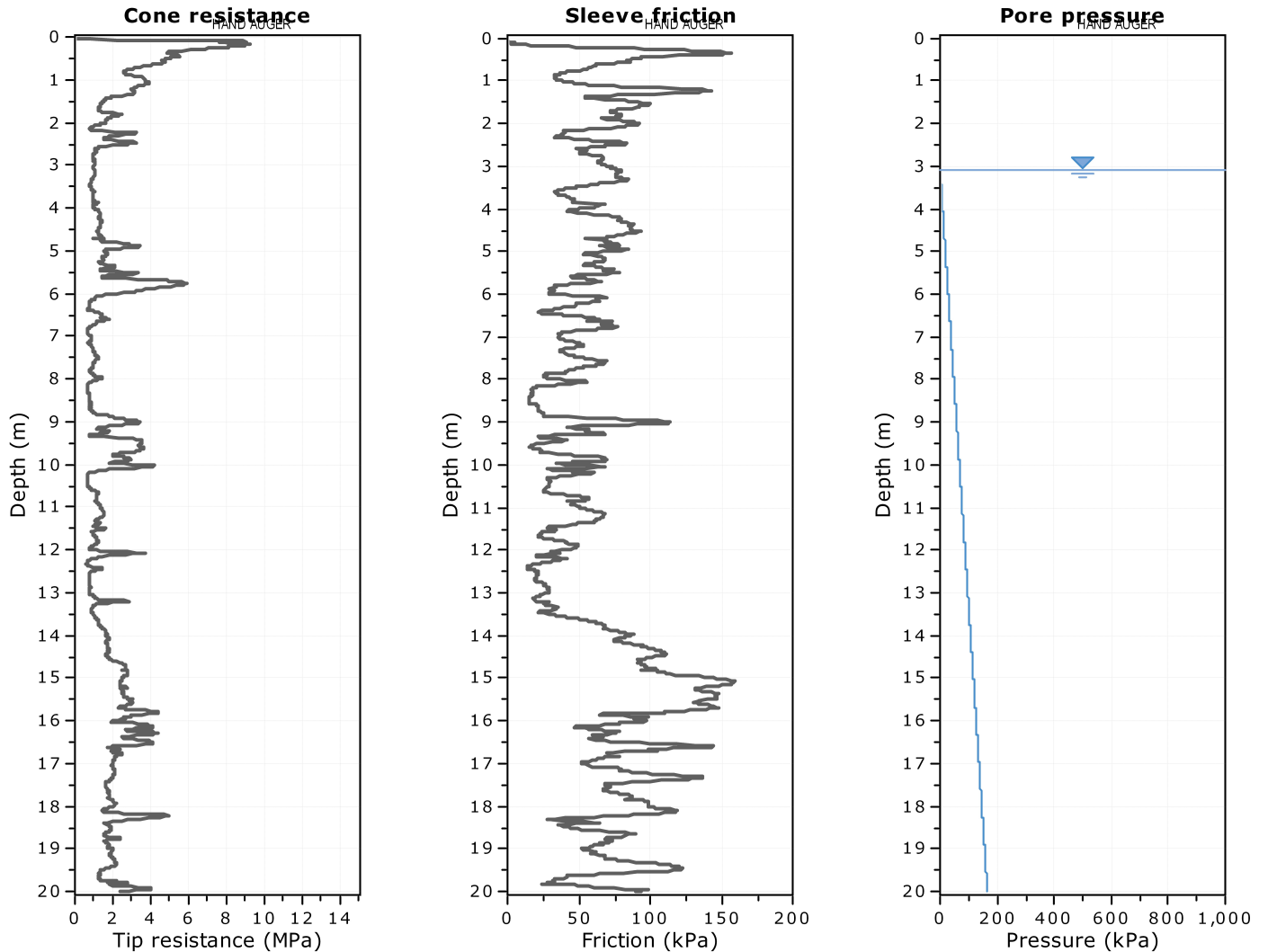
General statistics

Total points in CPT file: 2000
Total points excluded: 303
Exclusion percentage: 15.15%
Number of layers detected: 21

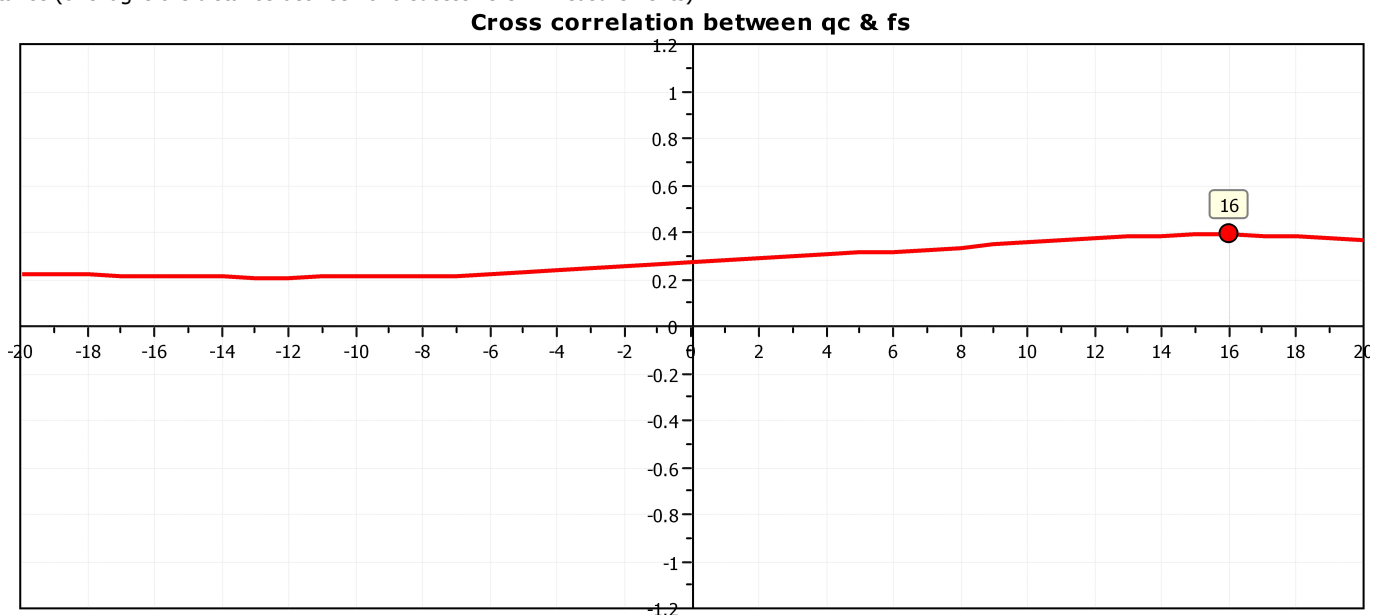


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Project: Comune Gambettola (FC)

Location: Microzonazione sismica III livello

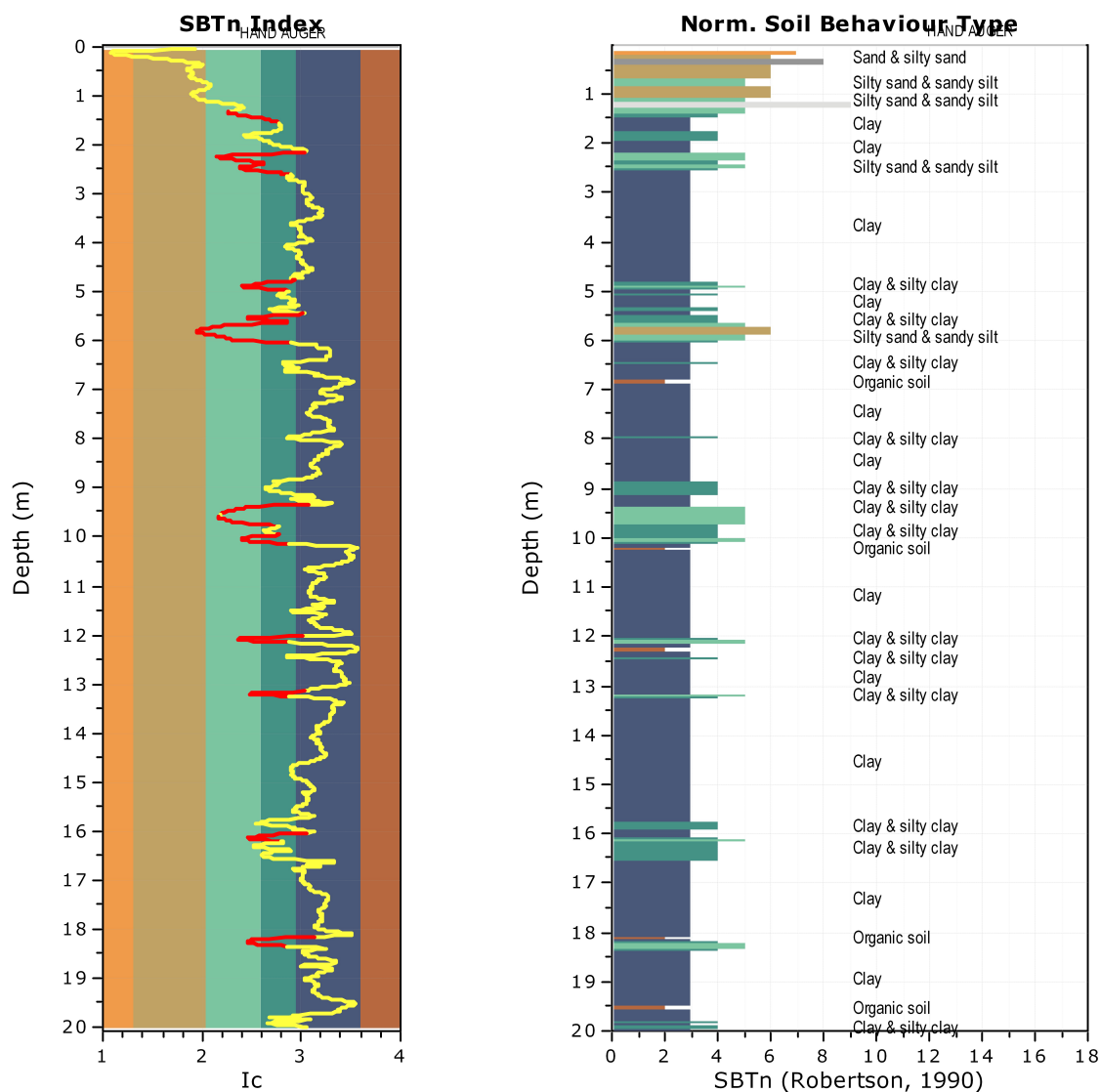
TRANSITION LAYER DETECTION ALGORITHM REPORT

Summary Details & Plots

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 I_c maximum check value: 3.00
 I_c change ratio value: 0.0010
Minimum number of points in layer: 4

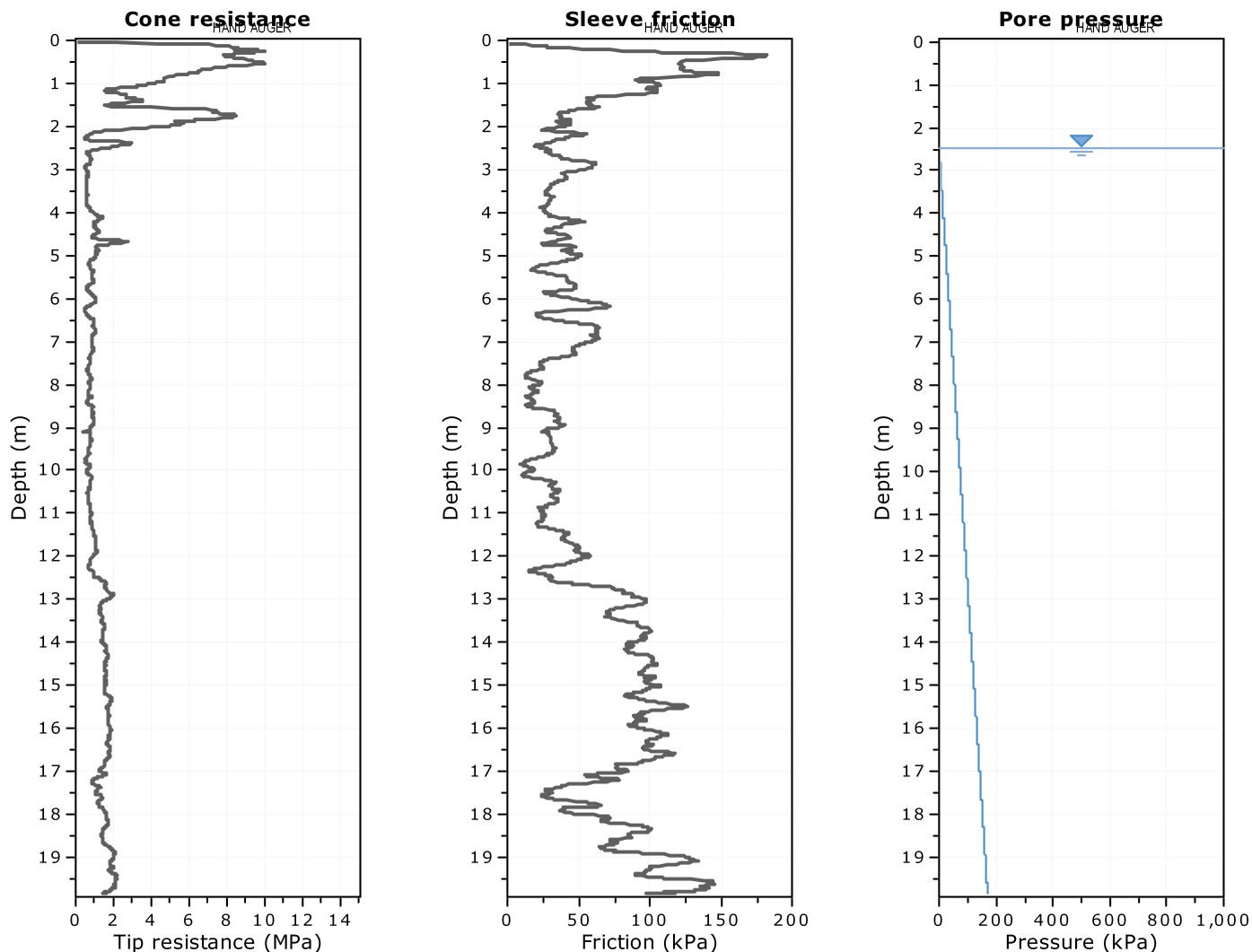
General statistics

Total points in CPT file: 2000
Total points excluded: 290
Exclusion percentage: 14.50%
Number of layers detected: 23

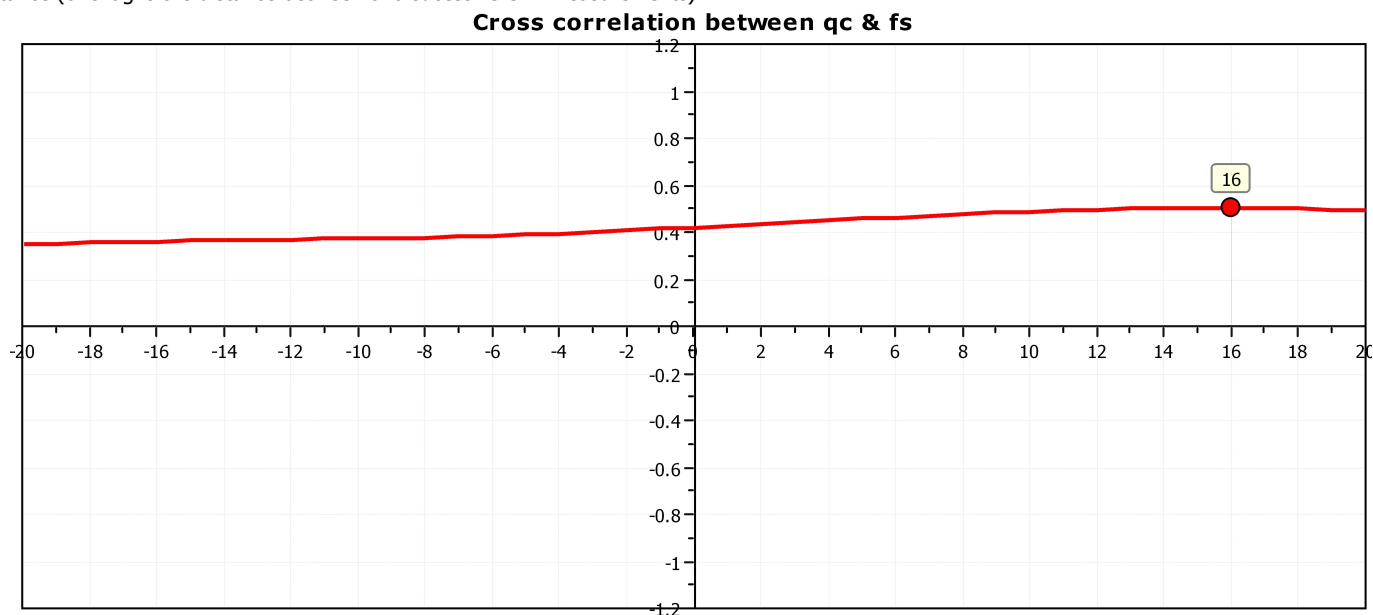


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Location: Microzonazione sismica III livello



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Project: Comune Gambettola (FC)

Location: Microzonazione sismica III livello

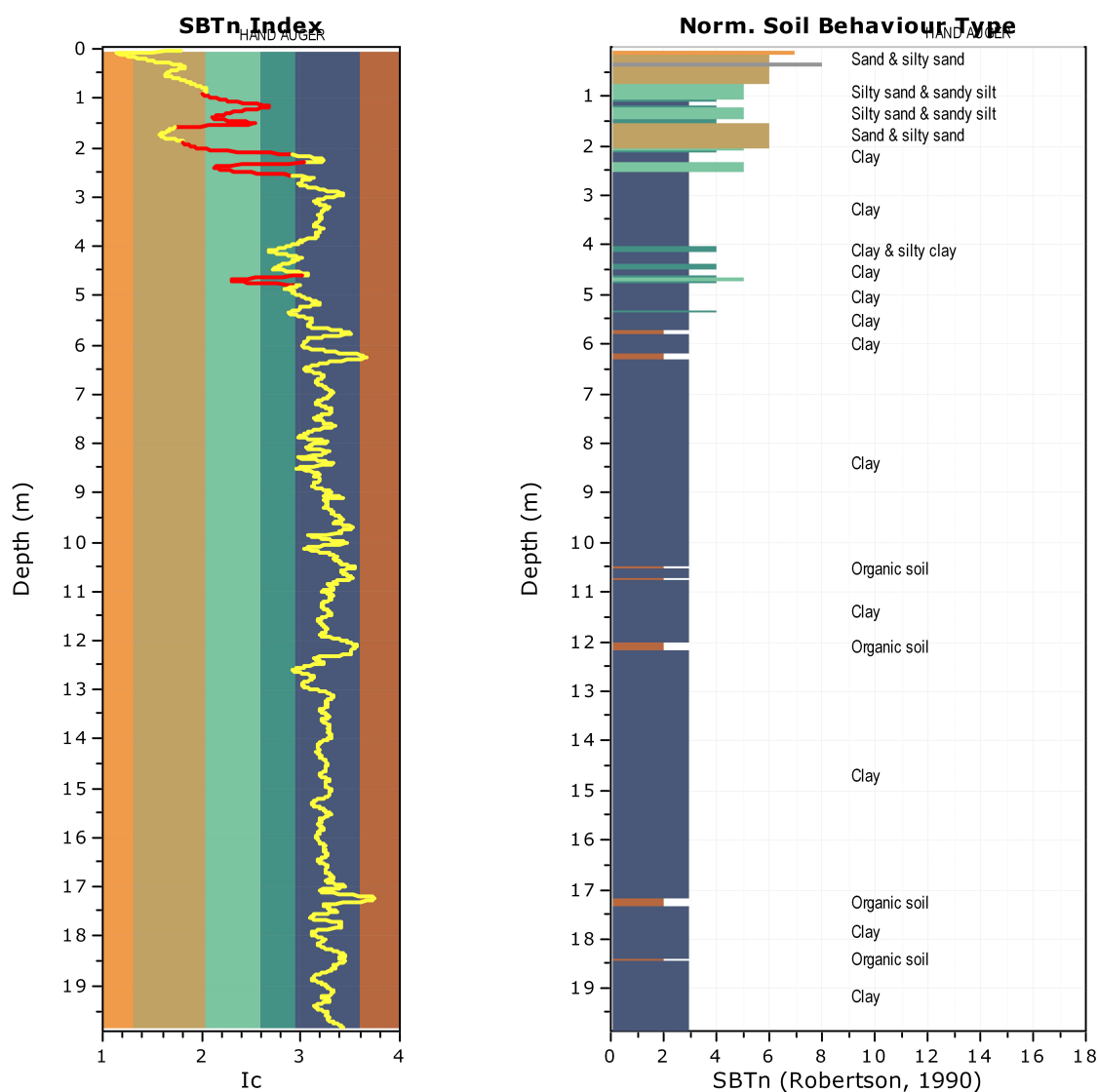
TRANSITION LAYER DETECTION ALGORITHM REPORT

Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vice-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between $1.80 < I_c < 3.0$) and a rate of change of I_c . Transitions typically occur when the rate of change of I_c is fast (i.e. ΔI_c is small).

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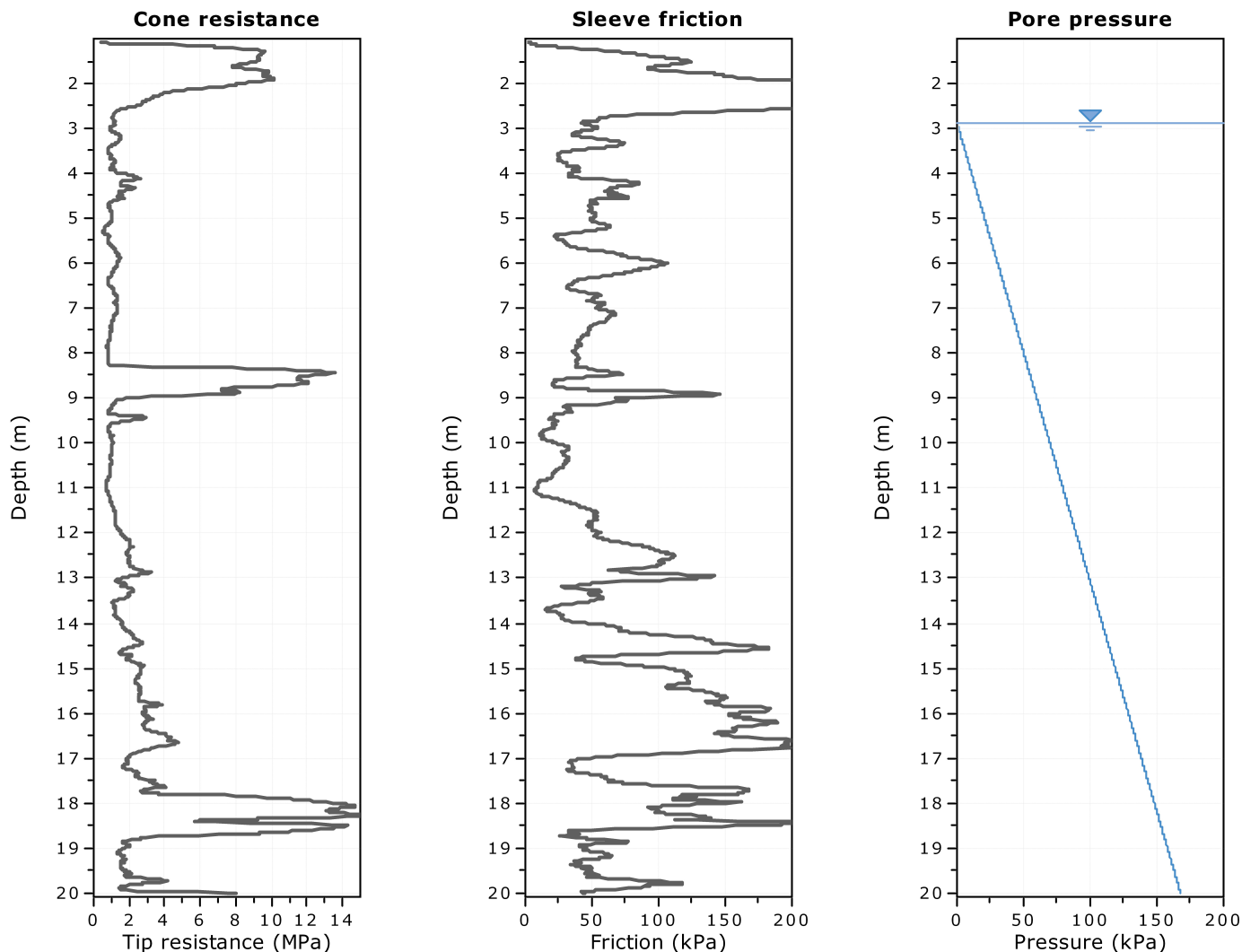


Transition layer algorithm properties

I_c minimum check value: 1.70
 I_c maximum check value: 3.00
 I_c change ratio value: 0.0010
Minimum number of points in layer: 4

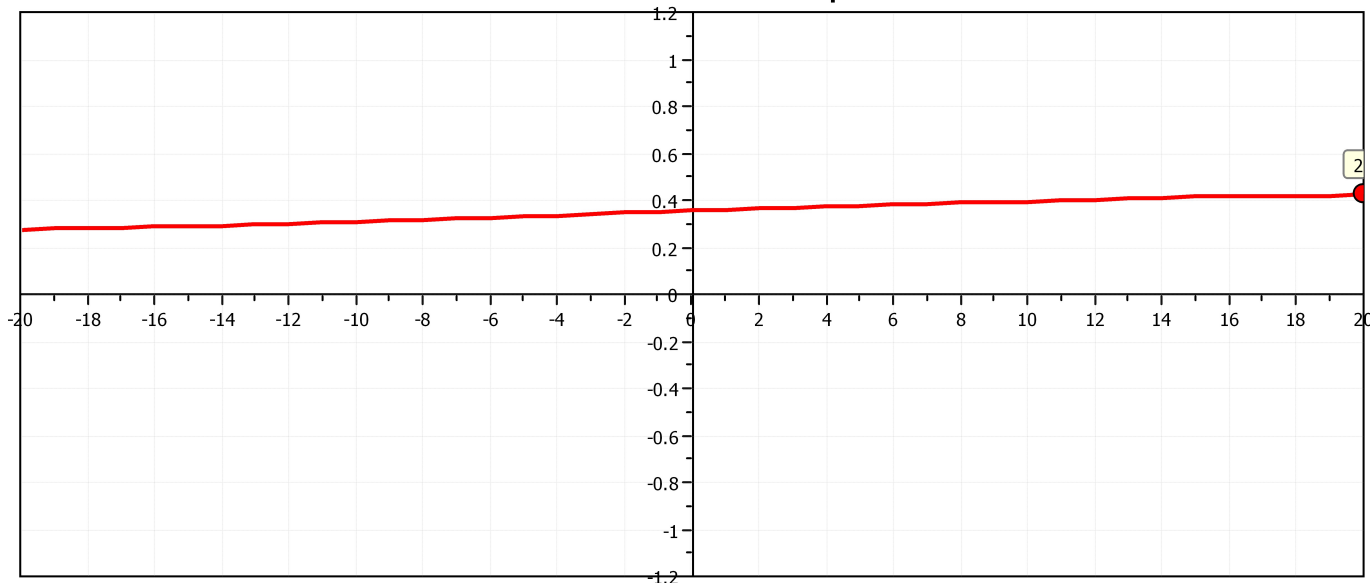
General statistics

Total points in CPT file: 1985
Total points excluded: 147
Exclusion percentage: 7.41%
Number of layers detected: 9



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Cross correlation between qc & fs





Project: Comune Gambettola (FC)

Location: Microzonazione sismica III livello

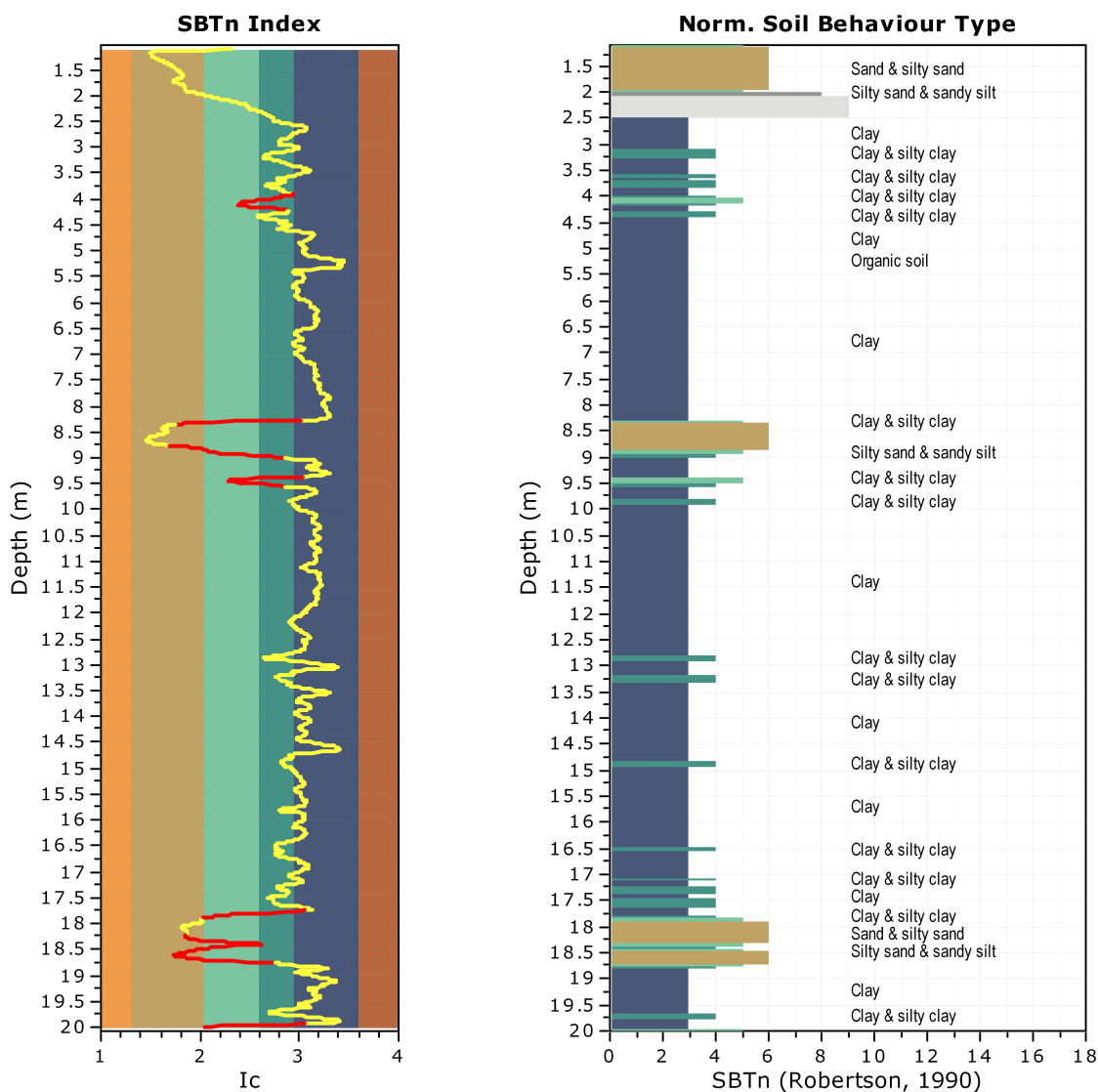
TRANSITION LAYER DETECTION ALGORITHM REPORT

Summary Details & Plots

Short description

The software will delete data when the cone is in transition from either clay to sand or vice-versa. To do this the software requires a range of I_c values over which the transition will be defined (typically somewhere between $1.80 < I_c < 3.0$) and a rate of change of I_c . Transitions typically occur when the rate of change of I_c is fast (i.e. ΔI_c is small).

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Transition layer algorithm properties

I_c minimum check value: 1.70
 I_c maximum check value: 3.00
 I_c change ratio value: 0.0010
Minimum number of points in layer: 4

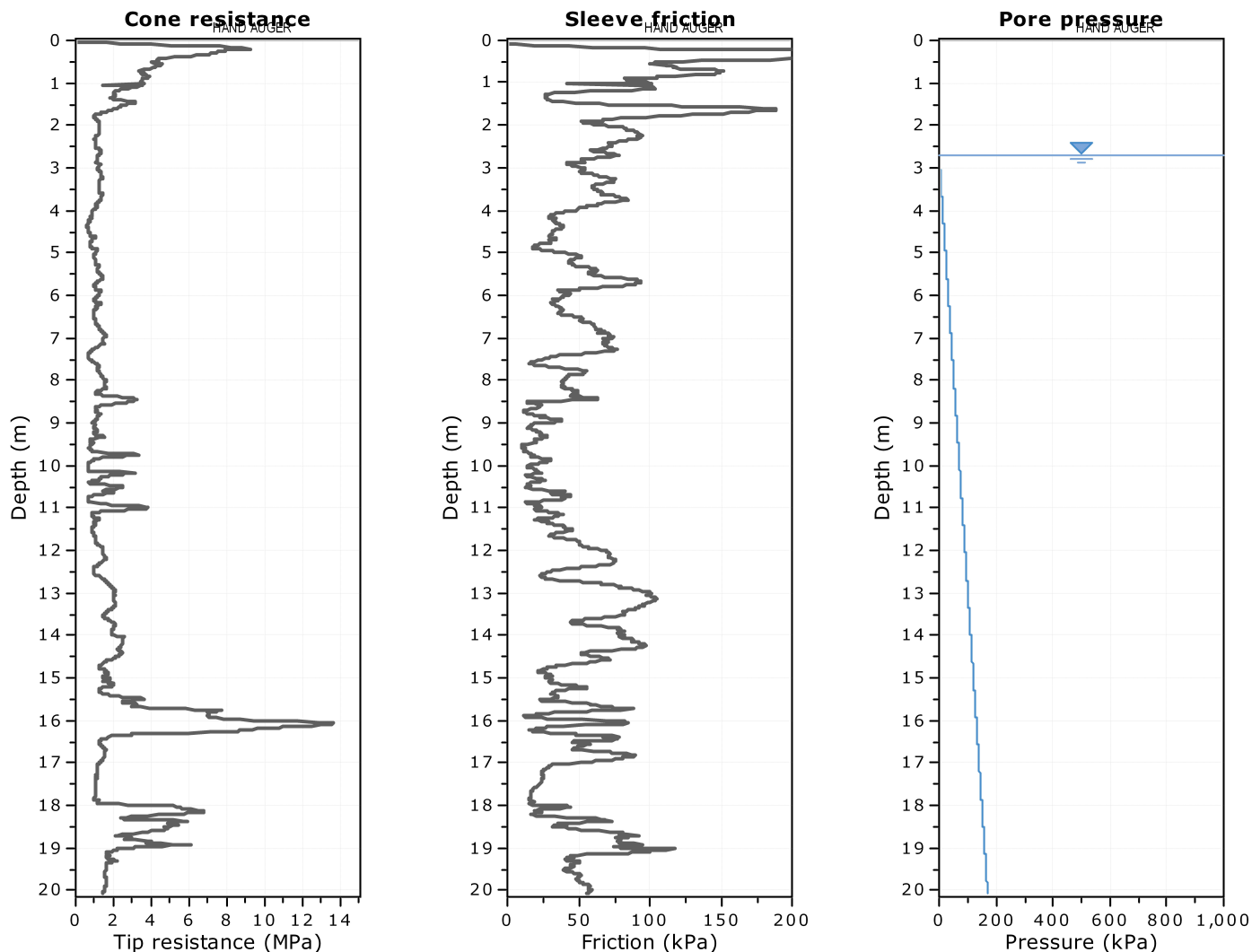
General statistics

Total points in CPT file: 1891
Total points excluded: 169
Exclusion percentage: 8.94%
Number of layers detected: 11



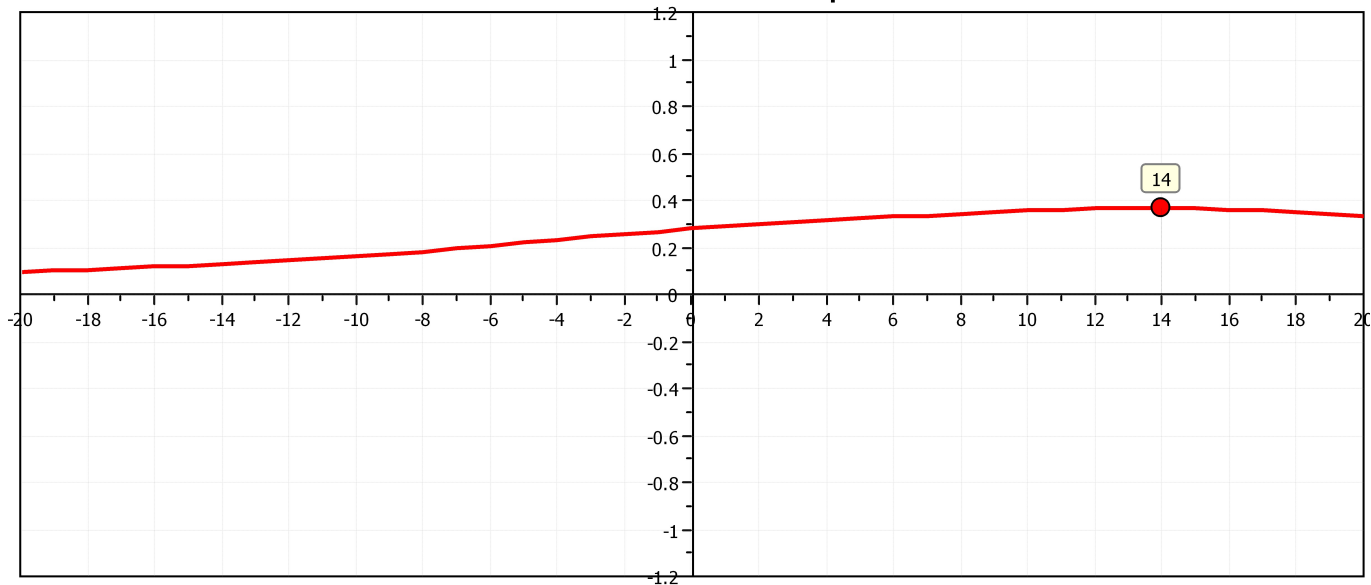
Project: Comune Gambettola (FC)

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Project: Comune Gambettola (FC)

Location: Microzonazione sismica III livello

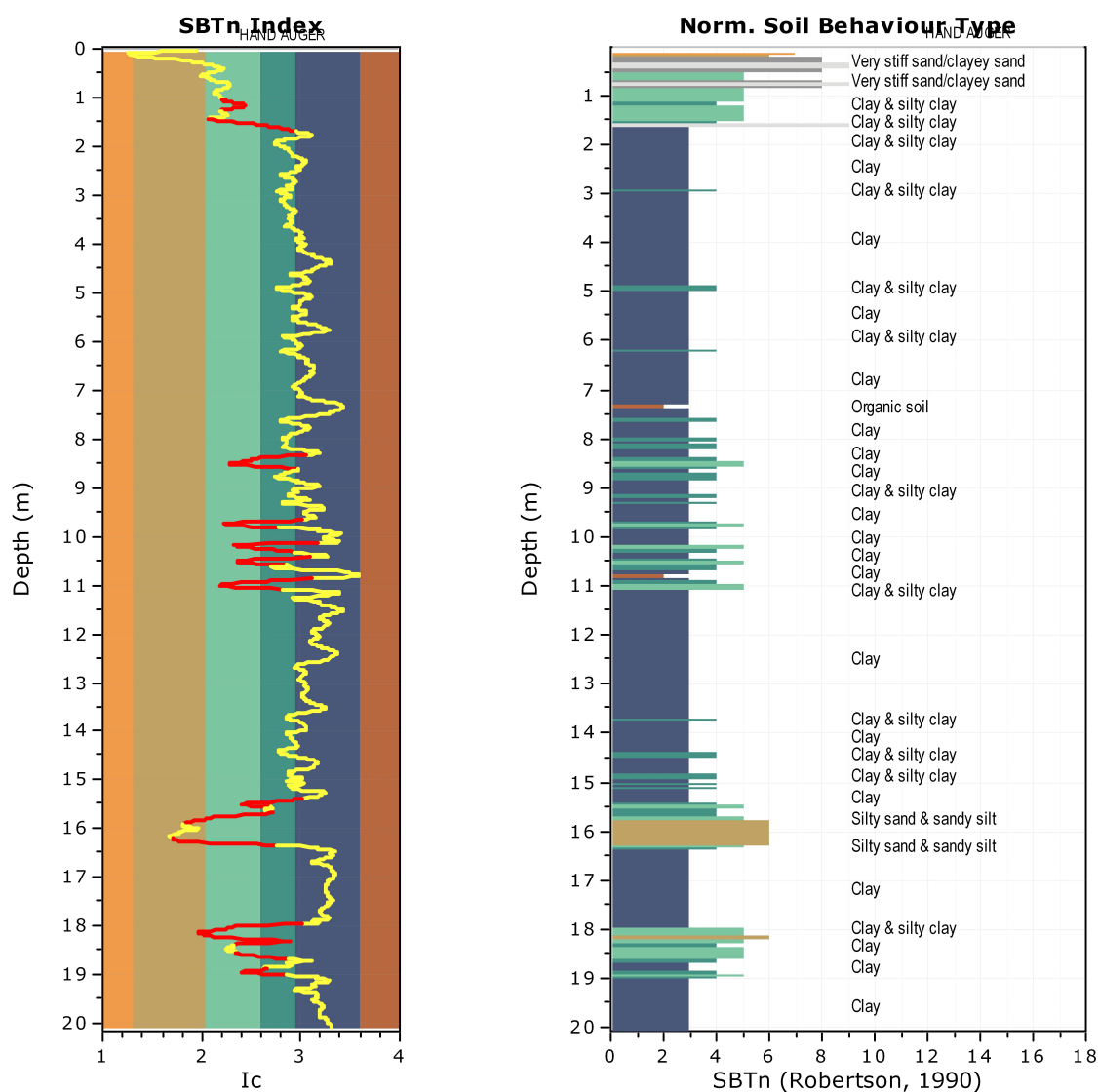
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I_c minimum check value: 1.70
 I_c maximum check value: 3.00
 I_c change ratio value: 0.0010
Minimum number of points in layer: 4

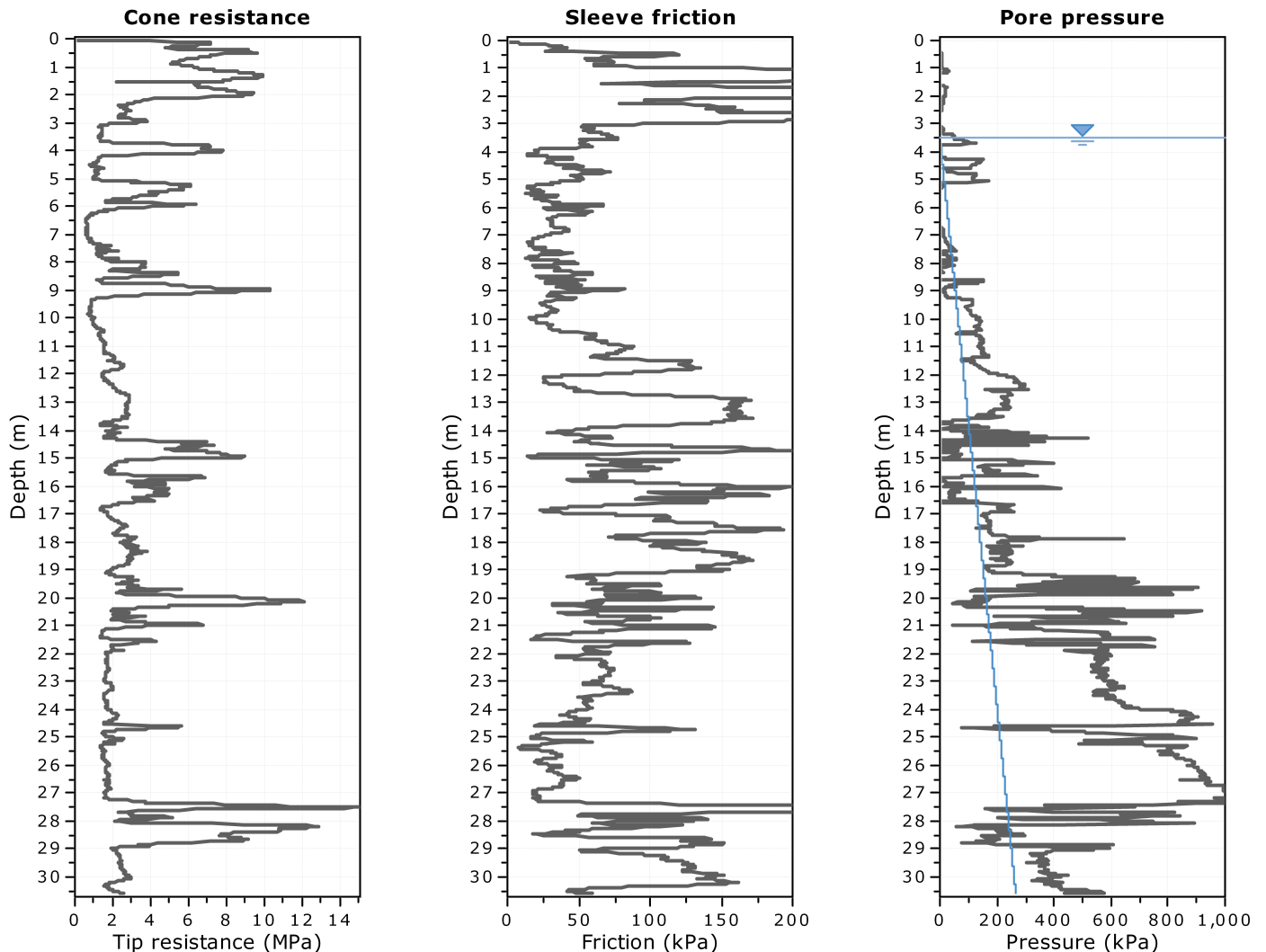
General statistics

Total points in CPT file: 2007
Total points excluded: 299
Exclusion percentage: 14.90%
Number of layers detected: 23



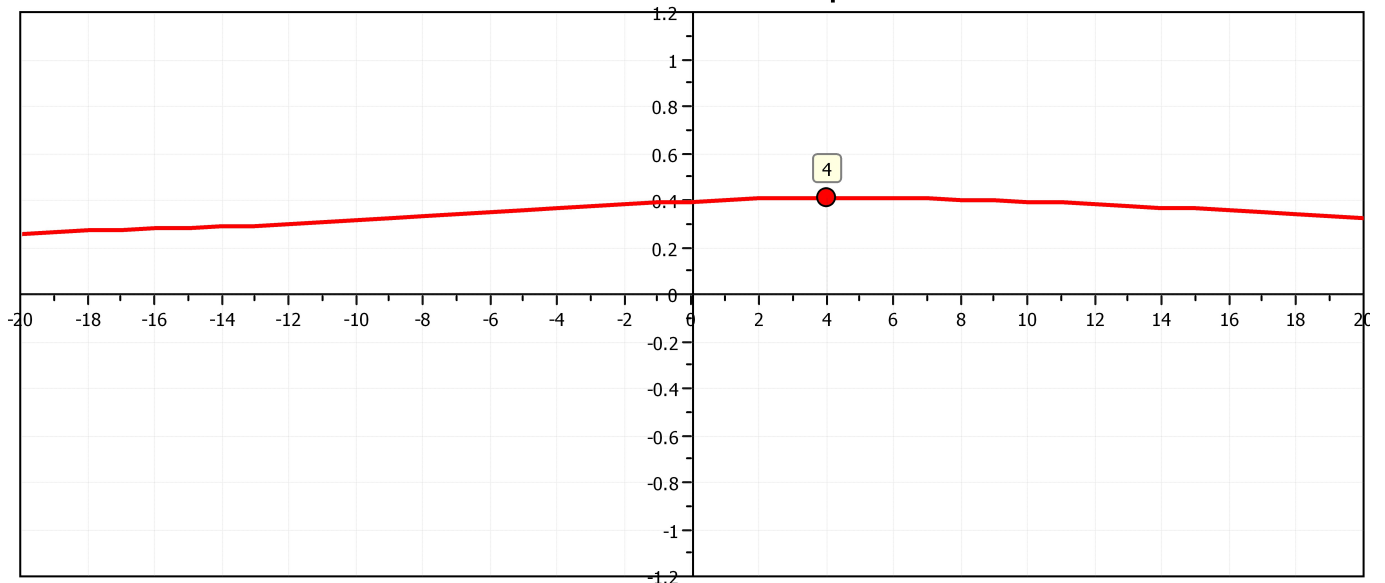
Project: Comune Gambettola (FC)

Location: Microzonazione sismica III livello



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Cross correlation between qc & fs





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Location: Microzonazione sismica III livello

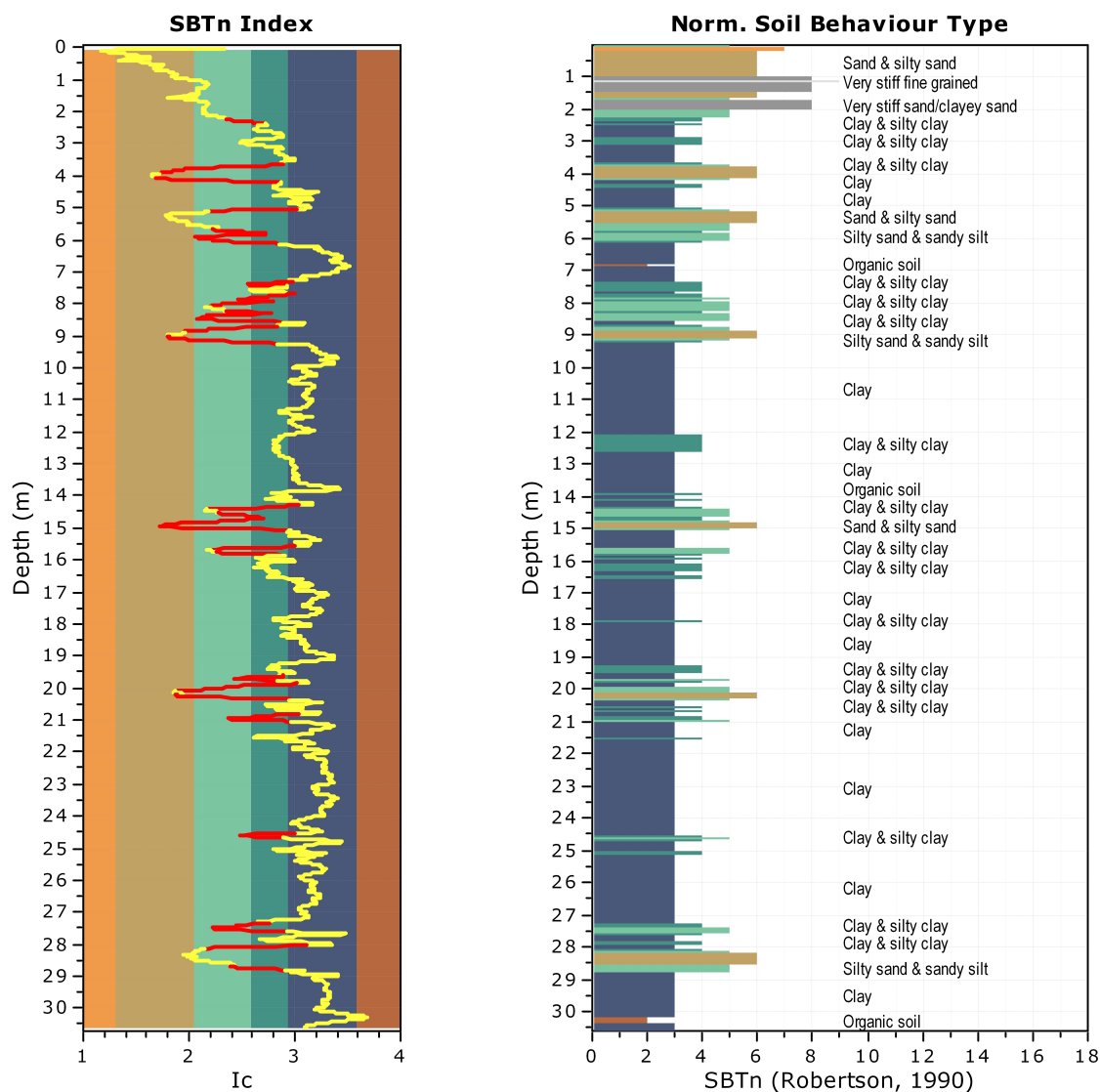
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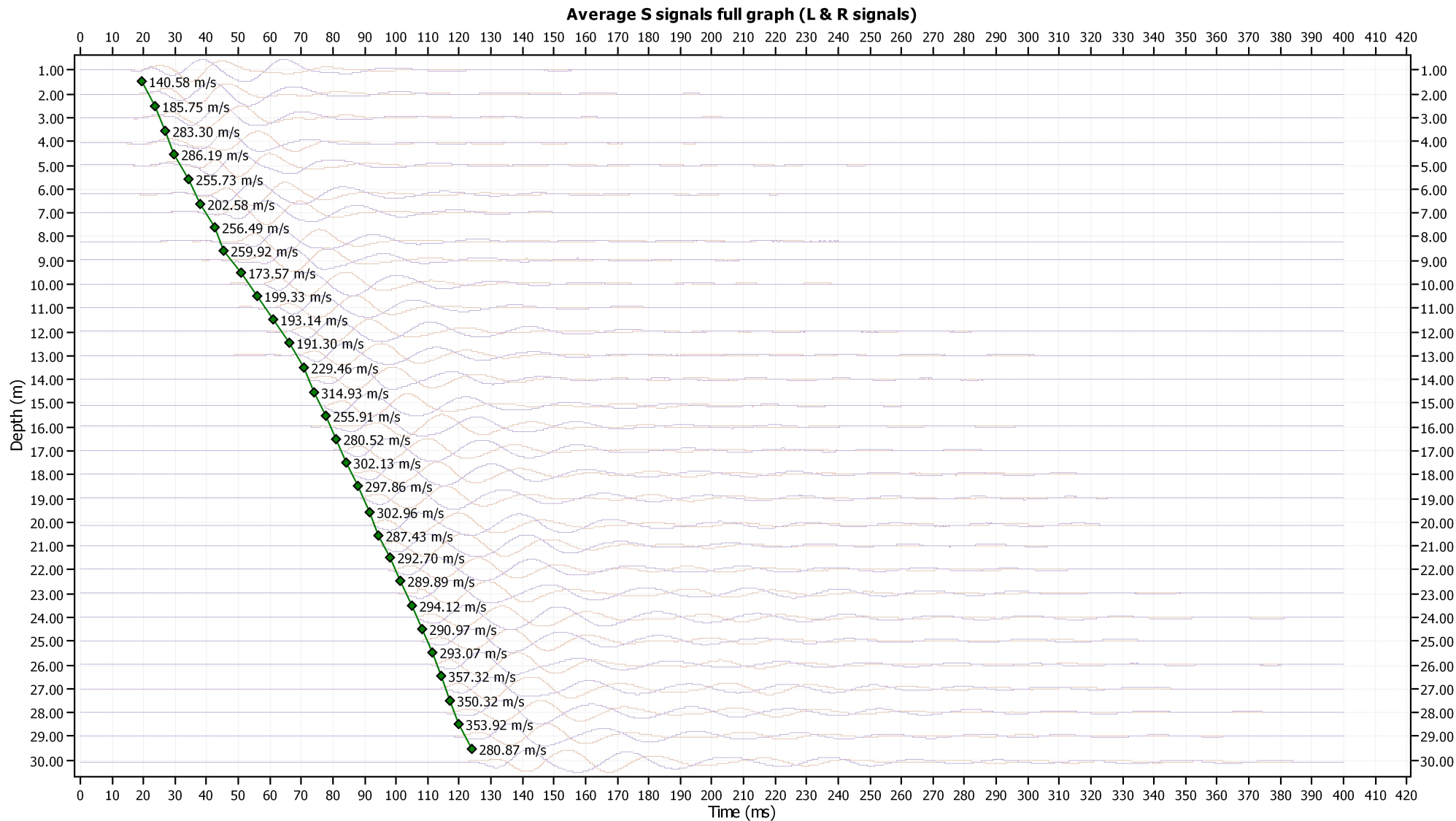


Transition layer algorithm properties

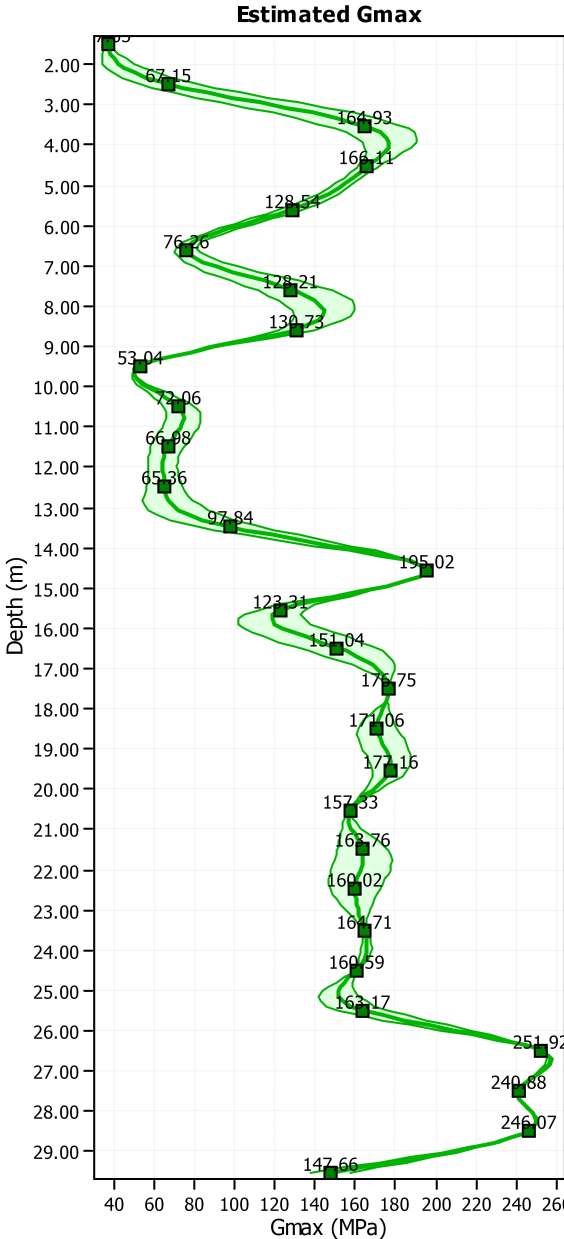
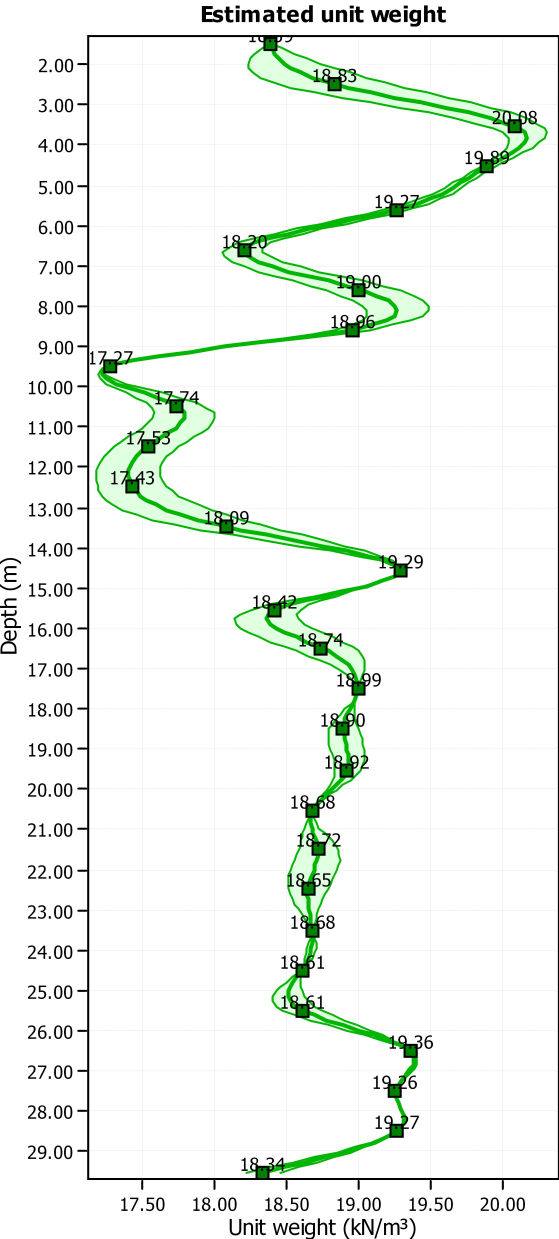
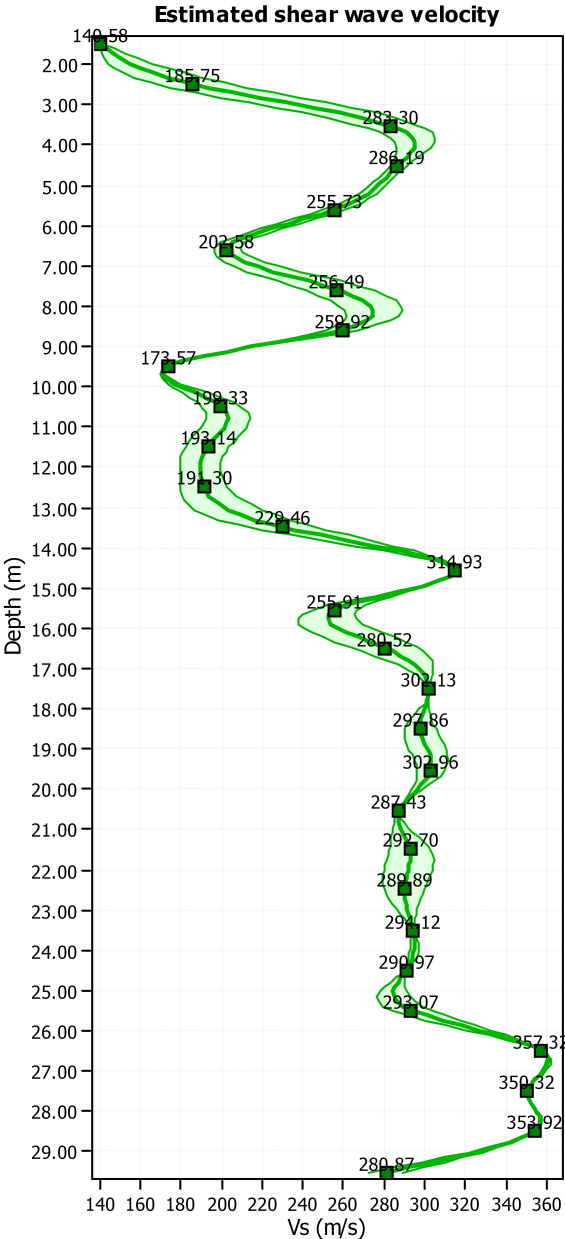
I_c minimum check value: 1.70
 I_c maximum check value: 3.00
 I_c change ratio value: 0.0010
Minimum number of points in layer: 4

General statistics

Total points in CPT file: 3059
Total points excluded: 511
Exclusion percentage: 16.70%
Number of layers detected: 35



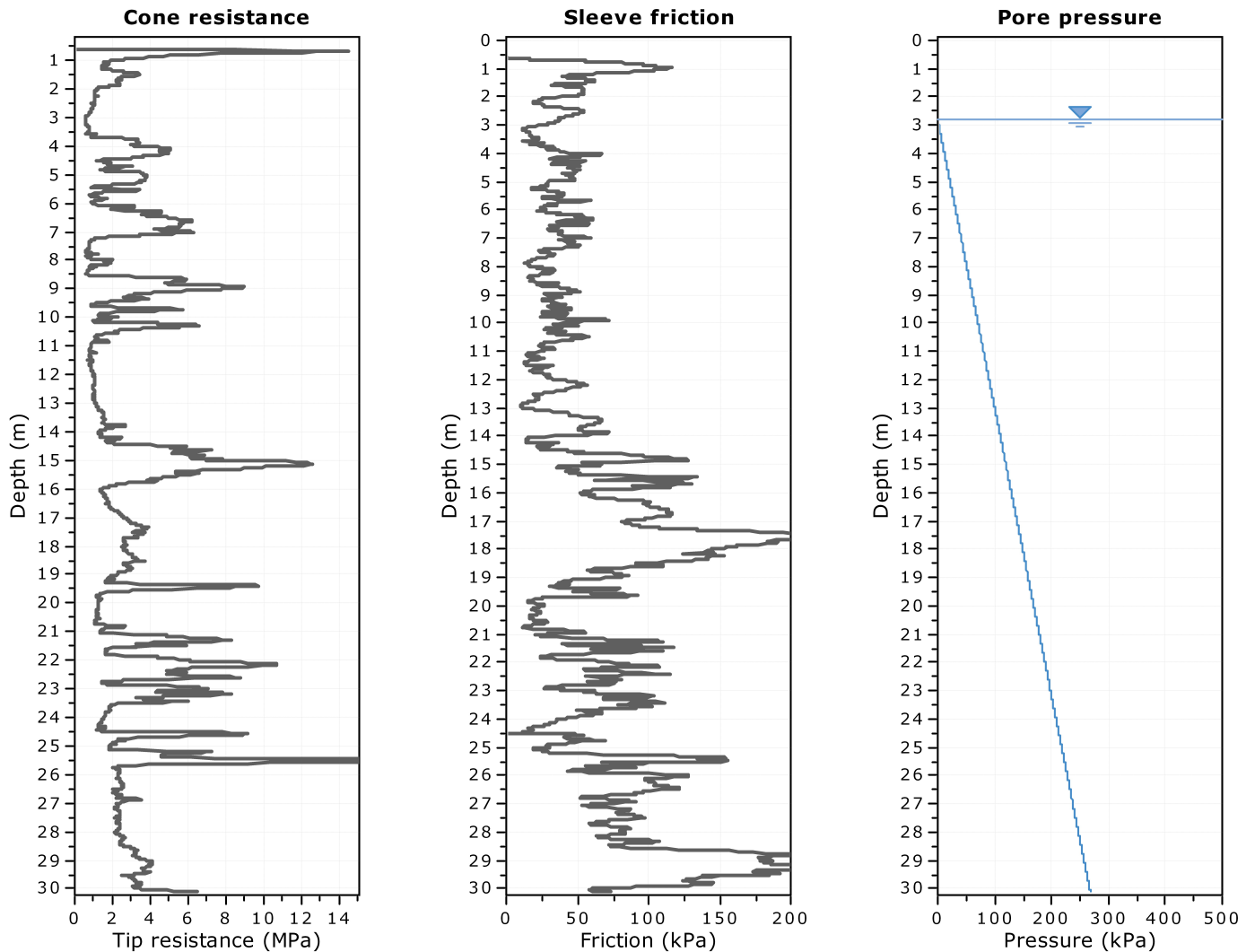
Detailed result plots over depth





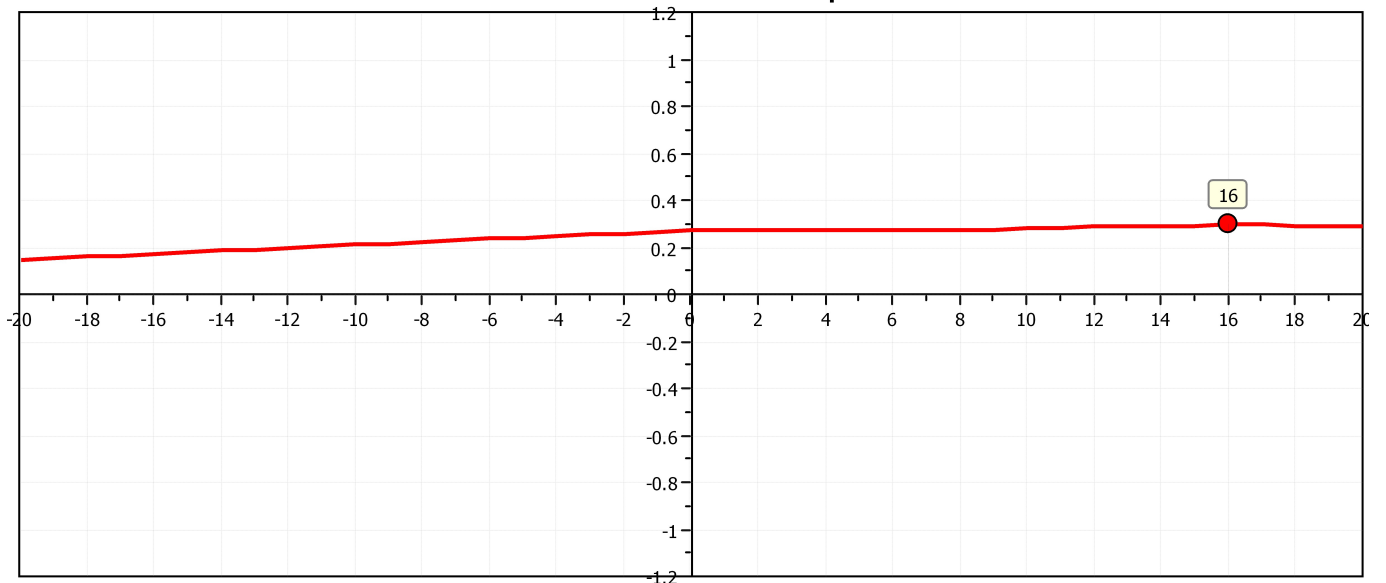
Project: Comune Gambettola (FC)

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Cross correlation between qc & fs





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Location: Microzonazione sismica III livello

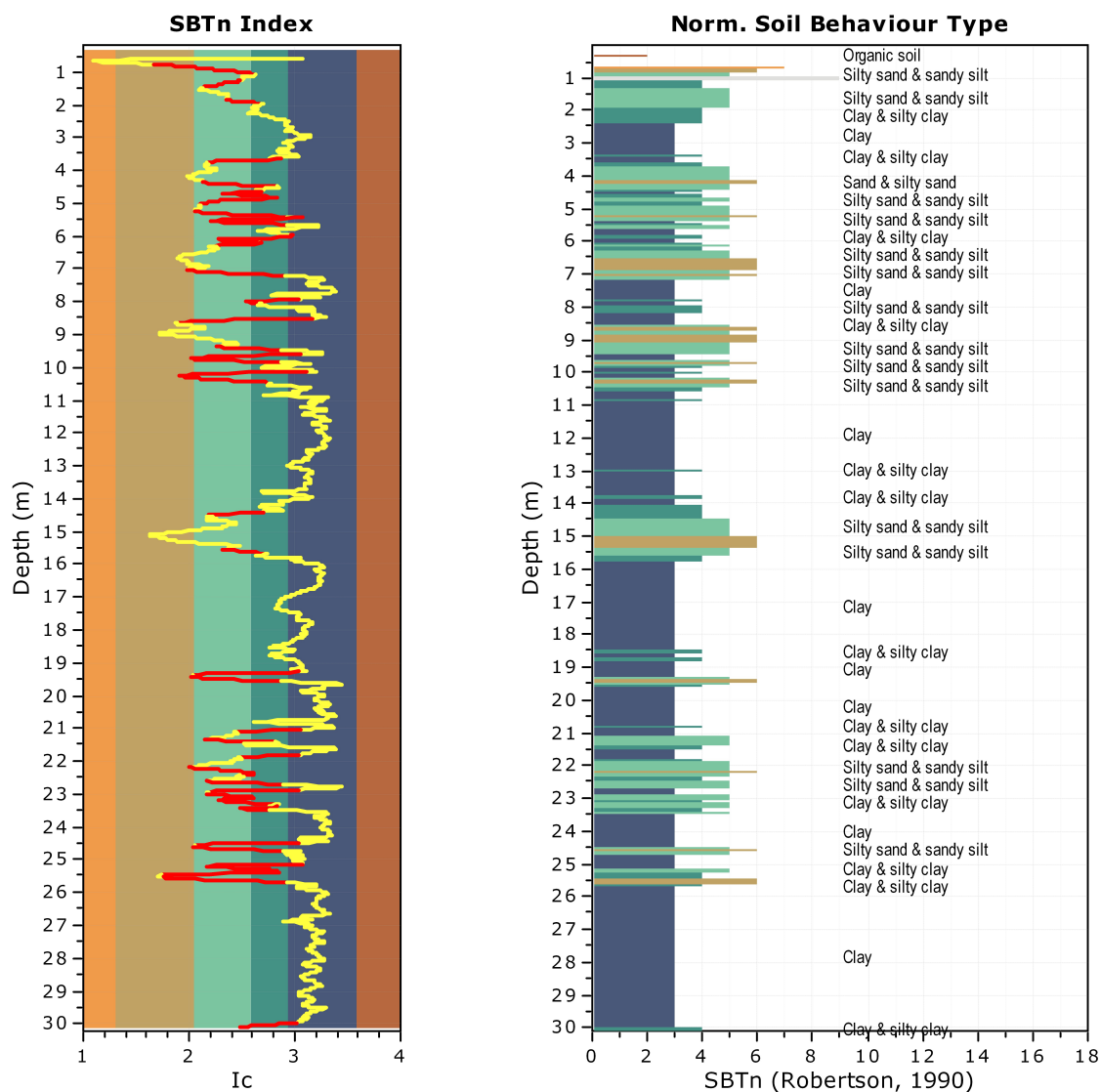
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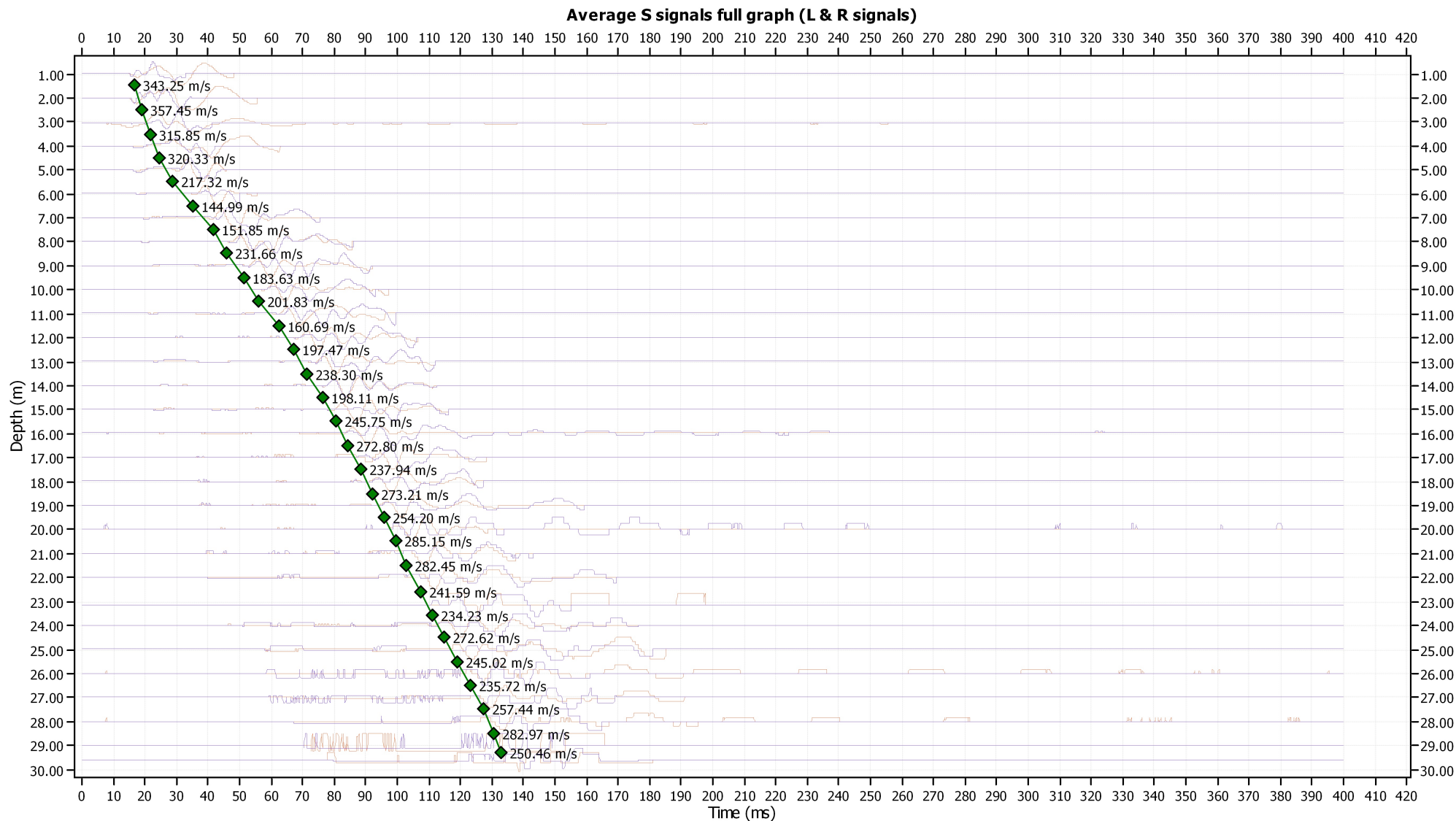


Transition layer algorithm properties

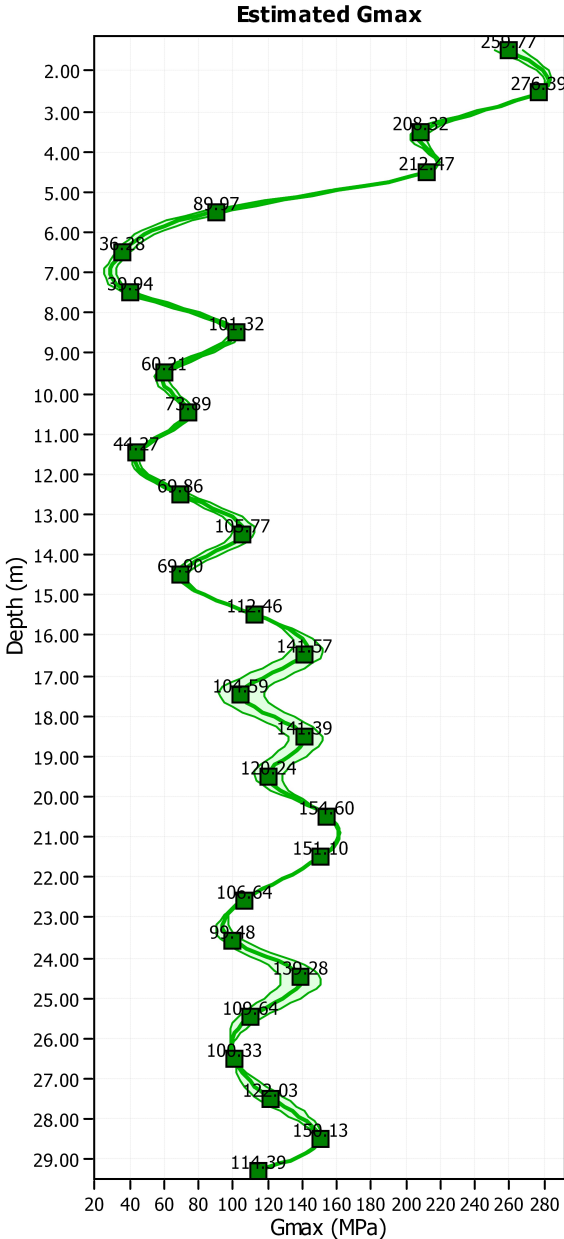
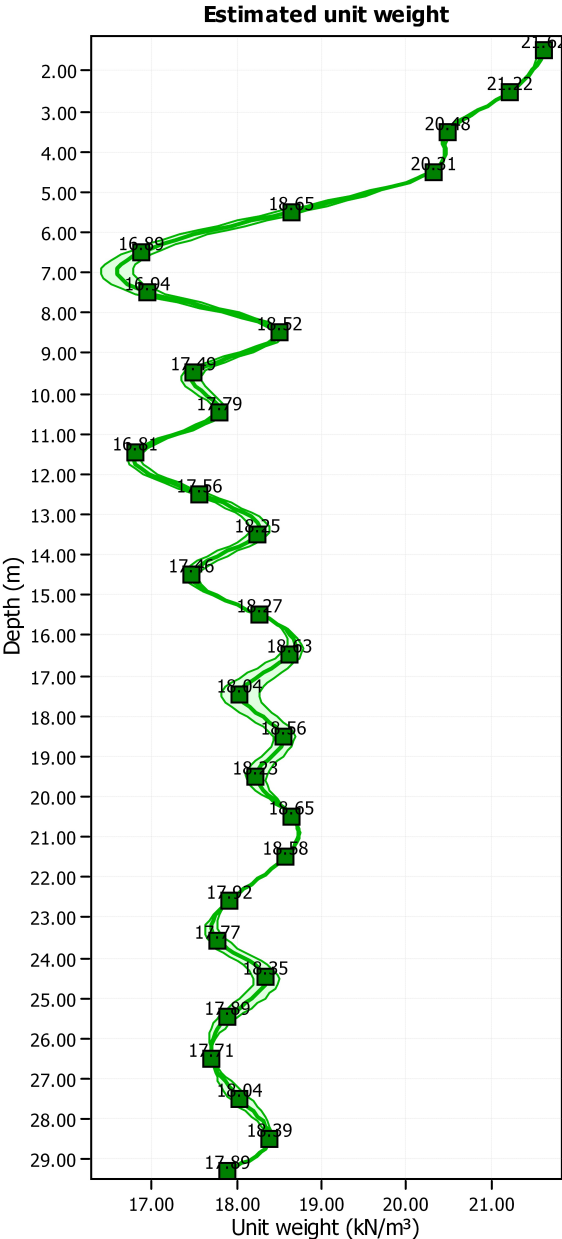
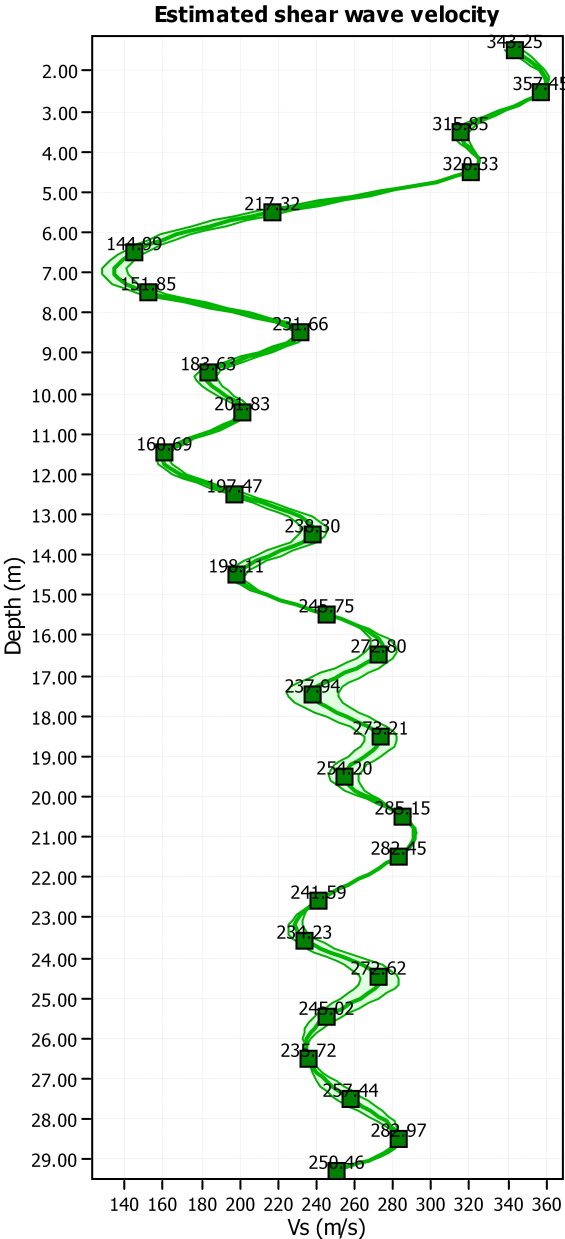
I_c minimum check value: 1.70
 I_c maximum check value: 3.00
 I_c change ratio value: 0.0010
Minimum number of points in layer: 4

General statistics

Total points in CPT file: 3010
Total points excluded: 609
Exclusion percentage: 20.23%
Number of layers detected: 46



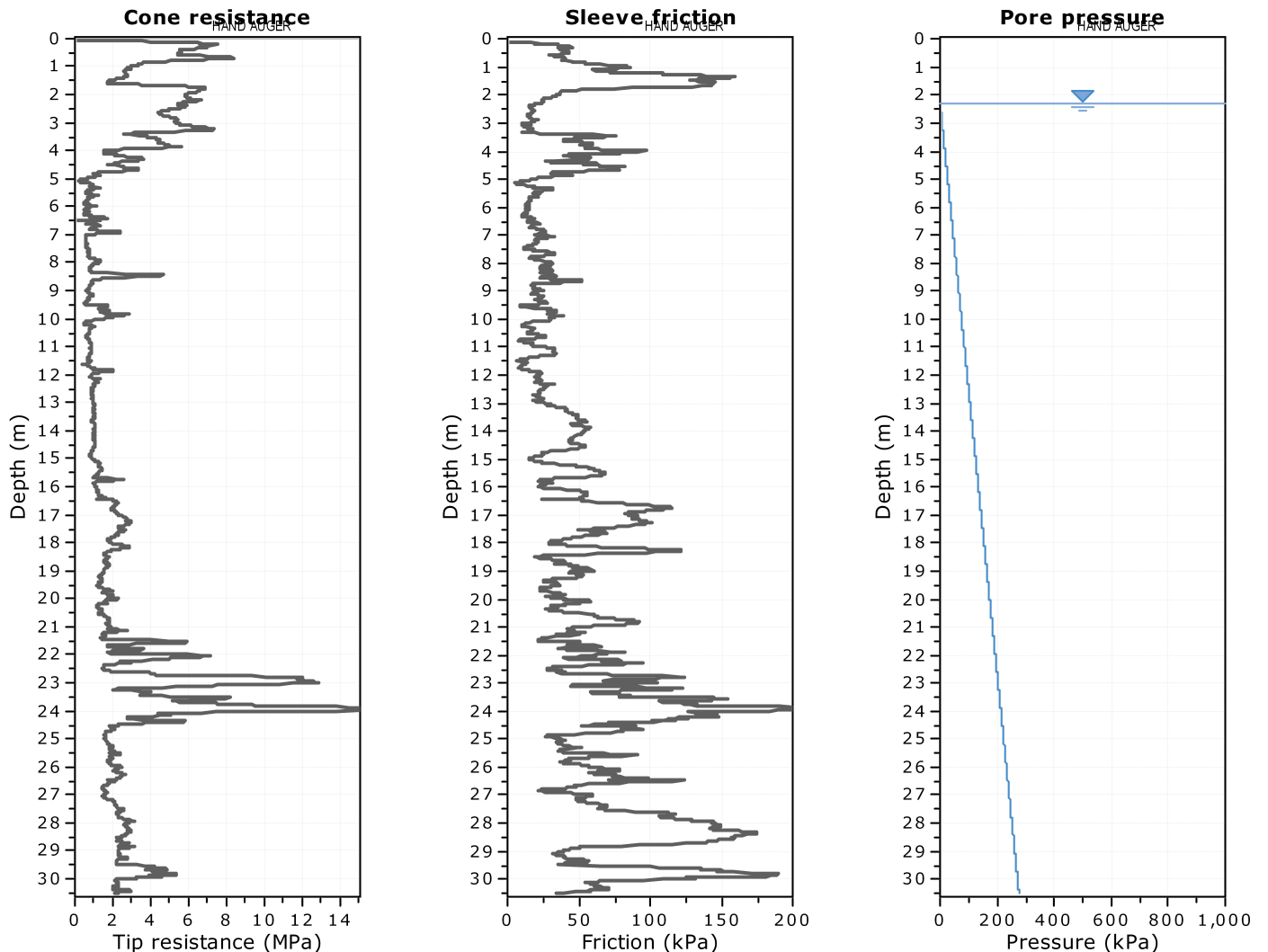
Detailed result plots over depth



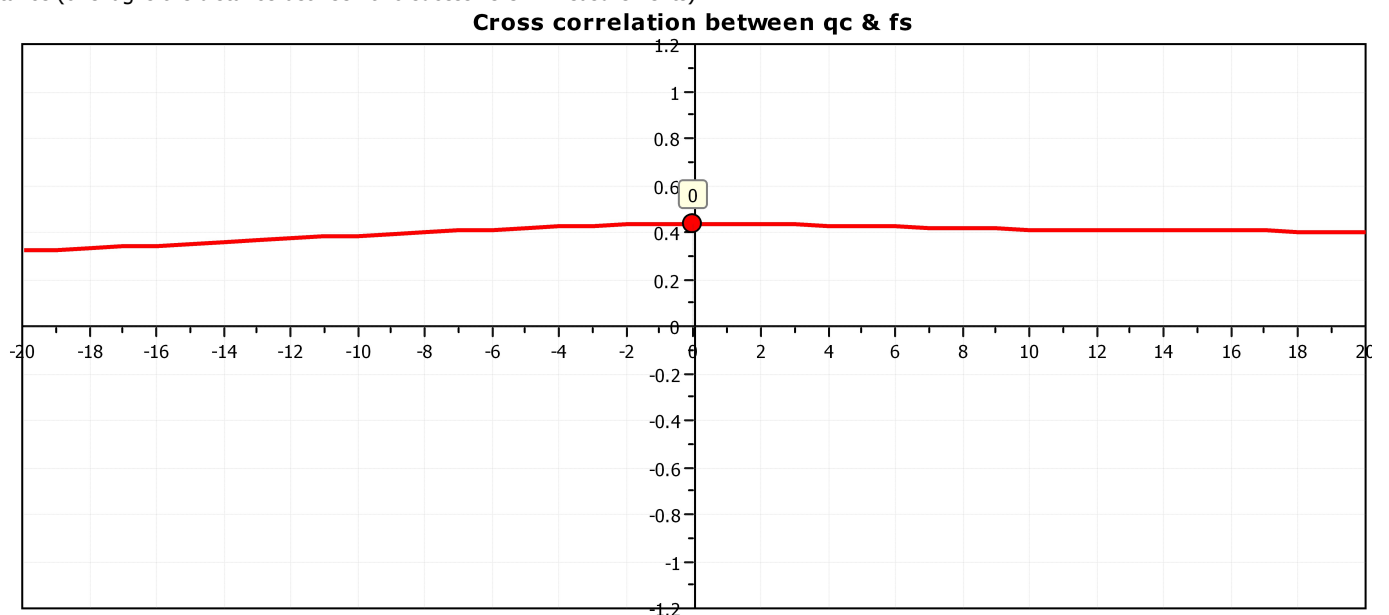


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Location: Microzonazione sismica III livello



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Location: Microzonazione sismica III livello

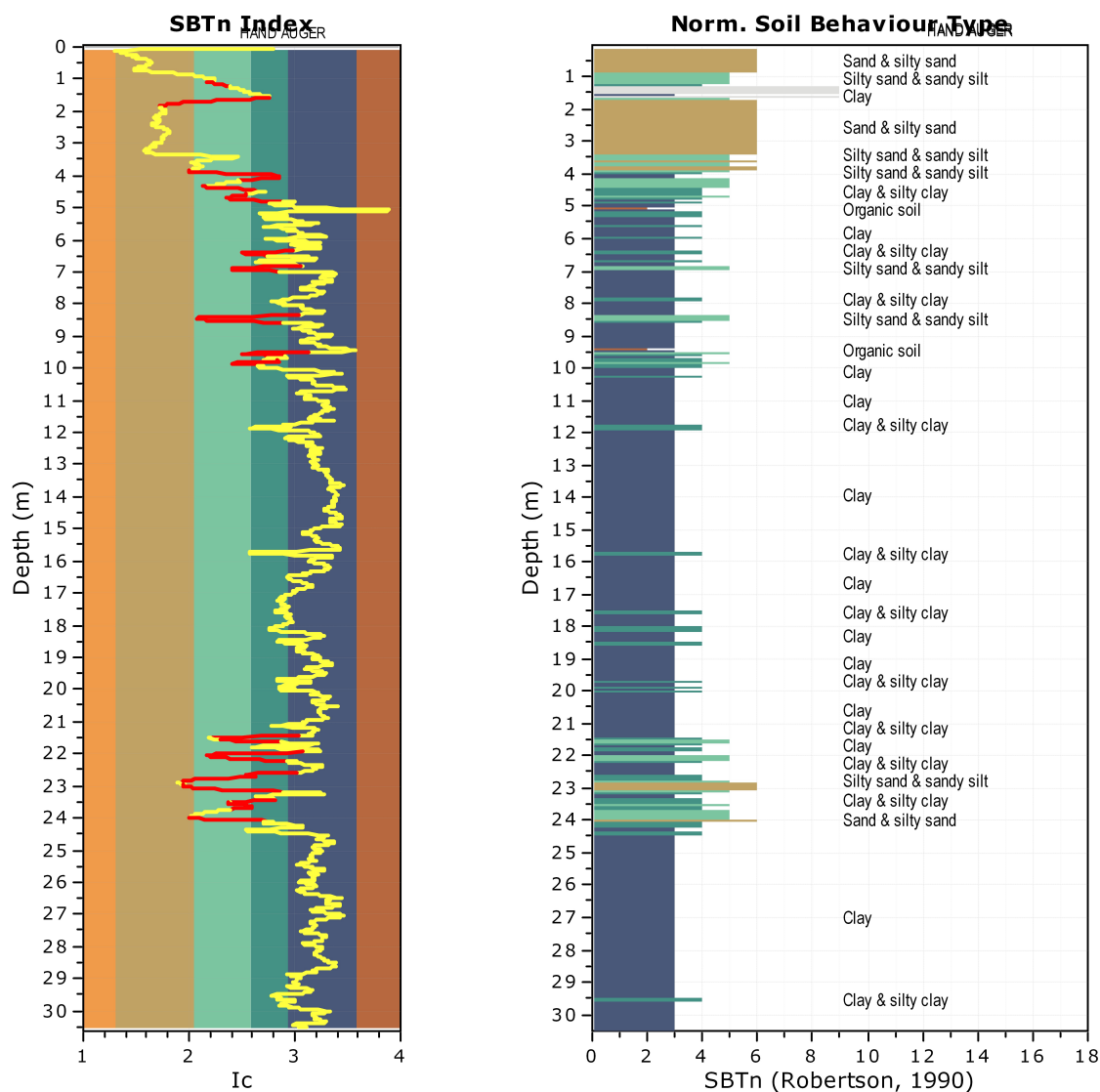
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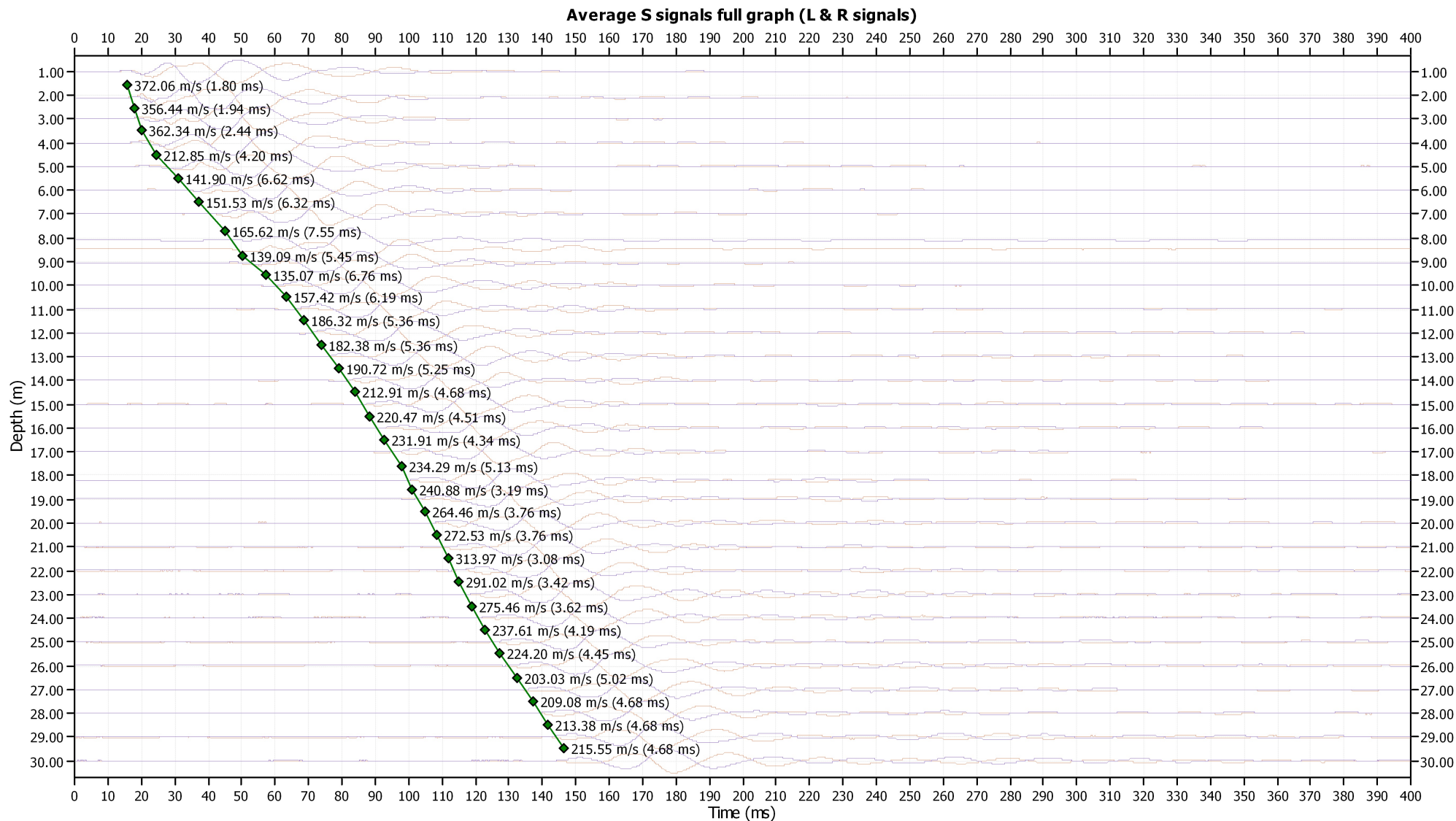


Transition layer algorithm properties

I_c minimum check value: 1.70
 I_c maximum check value: 3.00
 I_c change ratio value: 0.0010
Minimum number of points in layer: 4

General statistics

Total points in CPT file: 3051
Total points excluded: 363
Exclusion percentage: 11.90%
Number of layers detected: 29





GAM_HV1, Gambettola

Max. H/V at 1.07 ± 0.36 Hz (in the range 0.0 - 30.0 Hz).

Instrument: EXT- 24 bit USB

Data format: 16 byte

Full scale [mV]: n.a.

Start recording: 22/07/24 12:14:50 End recording: 22/07/24 12:34:50

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

GPS data not available1.07 > 0.50OK794.9 > 200OKExceeded 0 out of 34 timesOK

Trace length: 0h20'00". Analyzed 62% trace (manual window selection)NO1.953 HzOK2.16 > 2OK|0.33867| < 0.05NO0.36381 < 0.10742NO0.2545 < 1.78OK

Sampling rate: 200 Hz

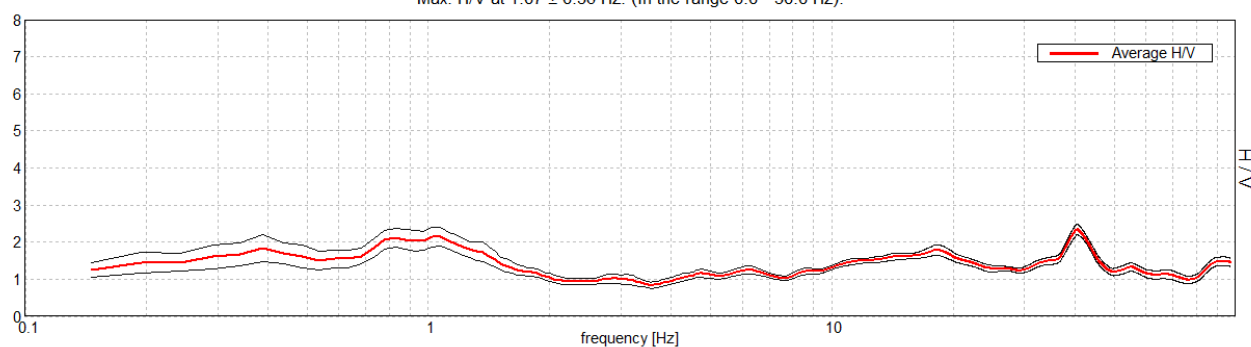
Window size: 20 s

Smoothing type: Triangular window

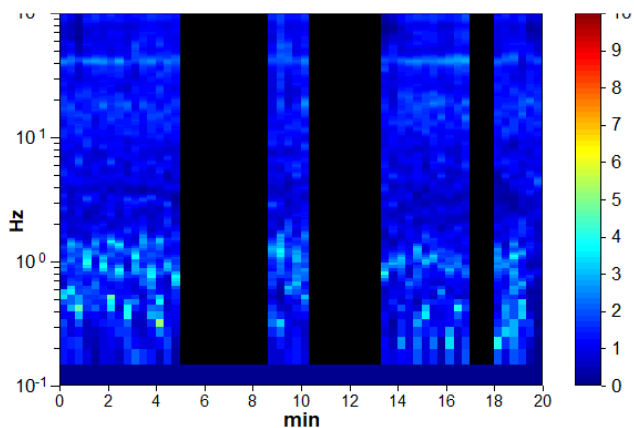
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

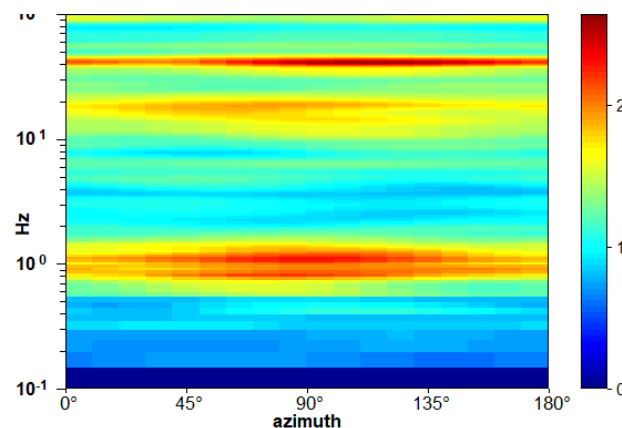
Max. H/V at 1.07 ± 0.36 Hz. (In the range 0.0 - 30.0 Hz).



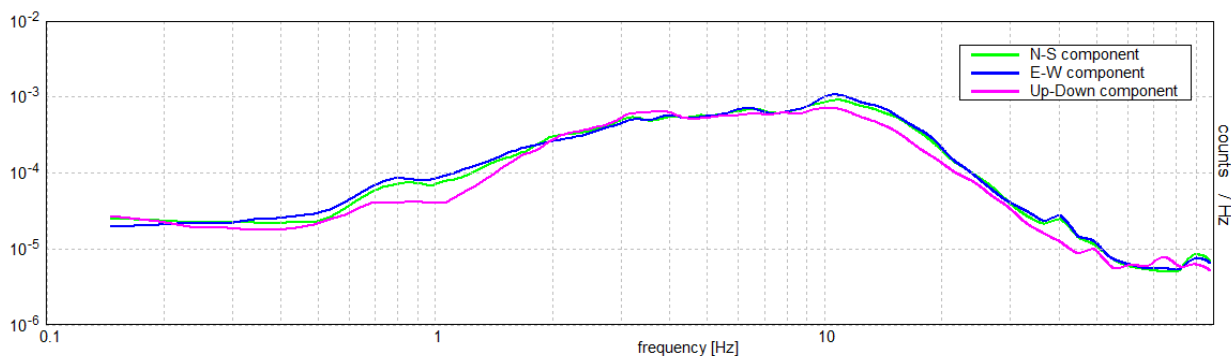
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA



GAM_HV2, Gambettola

Instrument: EXT- 24 bit USB

Data format: 16 byte

Full scale [mV]: n.a.

Start recording: 22/07/24 10:04:19 End recording: 22/07/24 10:24:19

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

GPS data not available

Trace length: 0h20'00". Analyzed 68% trace (manual window selection)

Sampling rate: 200 Hz

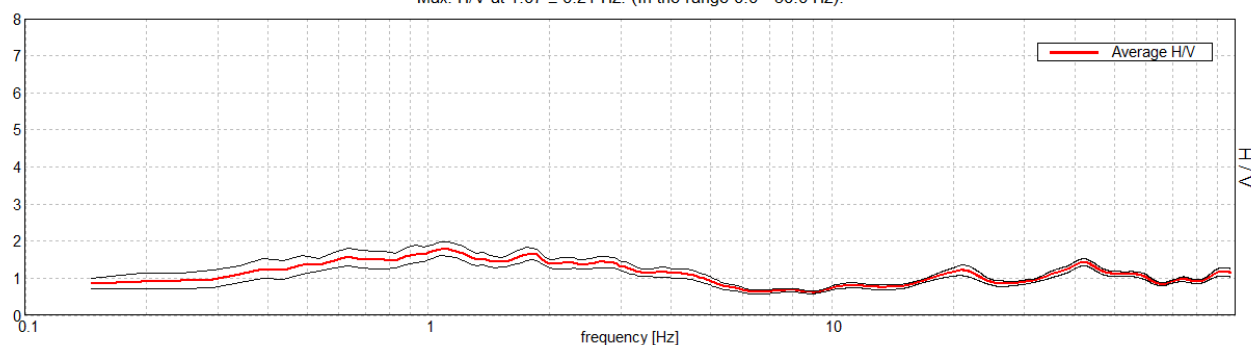
Window size: 20 s

Smoothing type: Triangular window

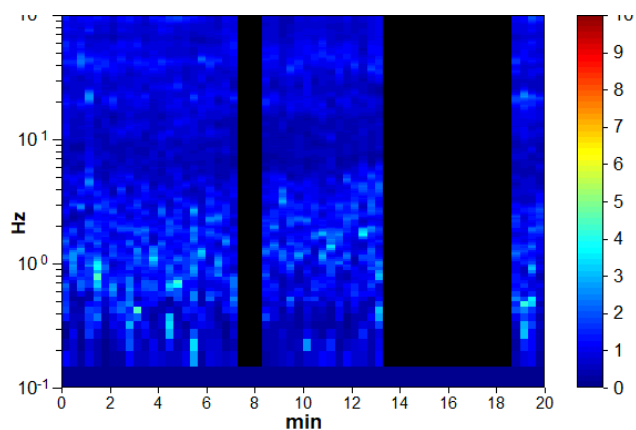
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

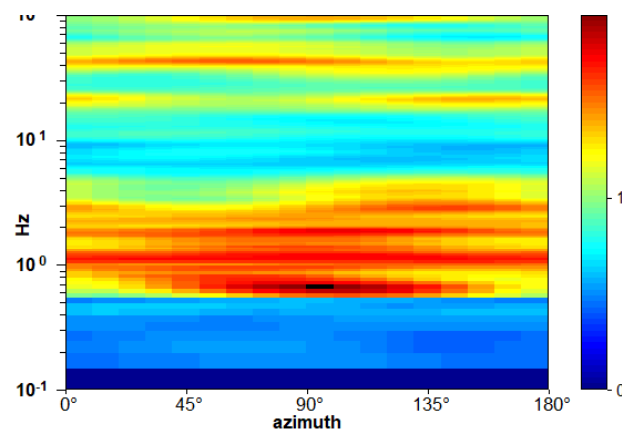
Max. H/V at 1.07 ± 0.21 Hz. (In the range 0.0 - 30.0 Hz).



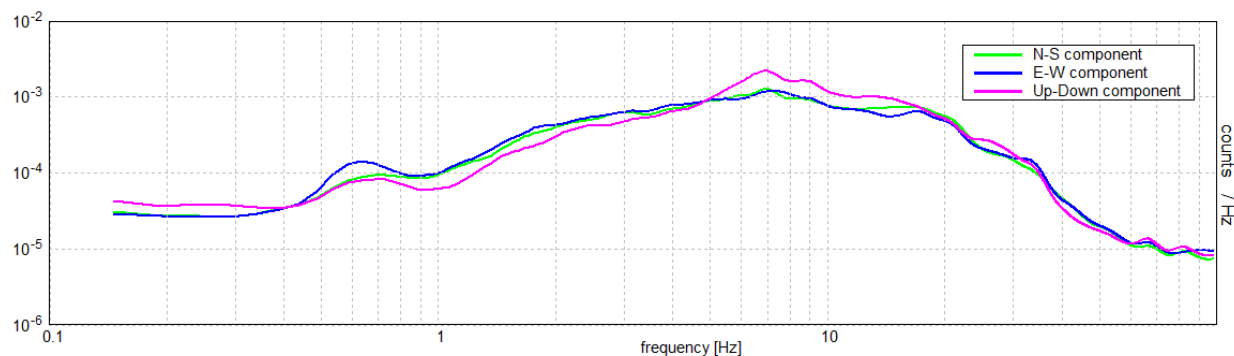
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA



[According to the SESAME, 2005 guidelines. Please read carefully the *Grilla* manual before interpreting the following tables.]

Max. H/V at 1.07 ± 0.21 Hz (in the range 0.0 - 30.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$1.07 > 0.50$	OK	
$n_c(f_0) > 200$	$880.9 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 34 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	$1.80 > 2$		NO
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.19467 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$0.20912 < 0.10742$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.1917 < 1.78$	OK	

L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{\log H/V}(f)$	standard deviation of $\log A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$

Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	$0.25 f_0$	$0.2 f_0$	$0.15 f_0$	$0.10 f_0$	$0.05 f_0$
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
$\log \theta(f_0)$ for $\sigma_{\log H/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

GAM_HV3, Gambettola

Instrument: EXT- 24 bit USB

Data format: 16 byte

Full scale [mV]: n.a.

Start recording: 22/07/24 11:17:31 End recording: 22/07/24 11:37:31

Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN

GPS data not available

Trace length: 0h20'00". Analyzed 65% trace (manual window selection)

Sampling rate: 200 Hz

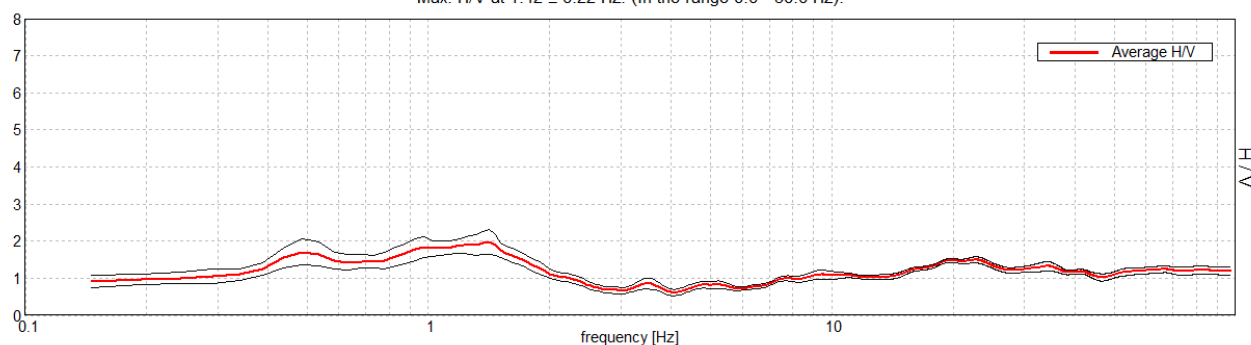
Window size: 20 s

Smoothing type: Triangular window

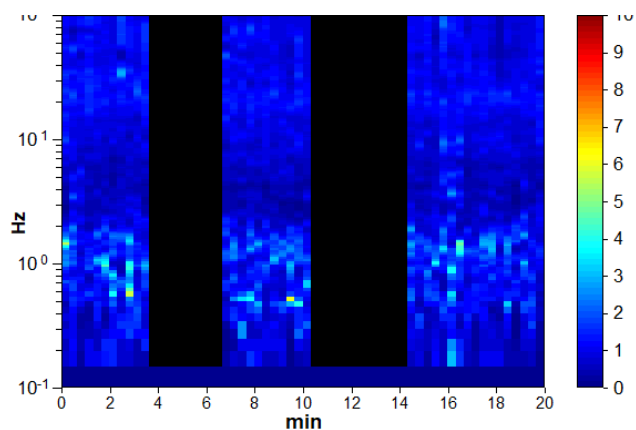
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

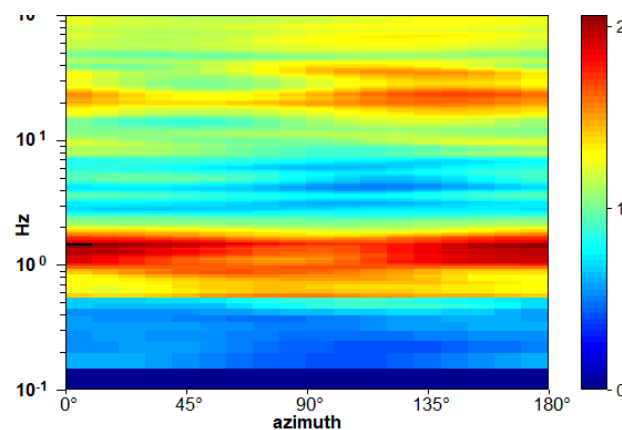
Max. H/V at 1.42 ± 0.22 Hz. (In the range 0.0 - 30.0 Hz).



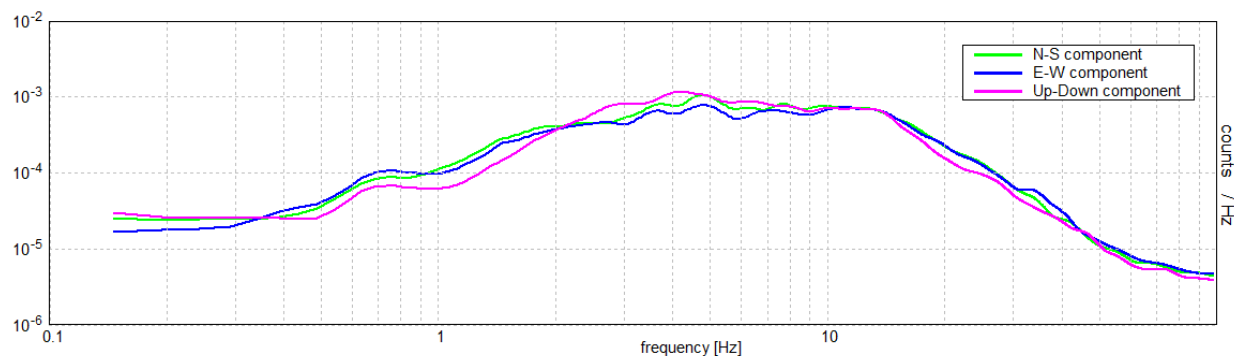
H/V TIME HISTORY



DIRECTIONAL H/V



SINGLE COMPONENT SPECTRA



[According to the SESAME, 2005 guidelines. **Please read carefully the *Grilla* manual before interpreting the following tables.**]

Max. H/V at 1.42 ± 0.22 Hz (in the range 0.0 - 30.0 Hz).

Criteria for a reliable H/V curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$1.42 > 0.50$	OK	
$n_c(f_0) > 200$	$1104.5 > 200$	OK	
$\sigma_A(f) < 2$ for $0.5f_0 < f < 2f_0$ if $f_0 > 0.5\text{Hz}$ $\sigma_A(f) < 3$ for $0.5f_0 < f < 2f_0$ if $f_0 < 0.5\text{Hz}$	Exceeded 0 out of 44 times	OK	

Criteria for a clear H/V peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$			NO
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	2.295 Hz	OK	
$A_0 > 2$	$1.97 > 2$		NO
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.15292 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$0.21654 < 0.1416$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.3377 < 1.78$	OK	

L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak amplitude at frequency f_0
$A_{H/V}(f)$	H/V curve amplitude at frequency f
f^-	frequency between $f_0/4$ and f_0 for which $A_{H/V}(f^-) < A_0/2$
f^+	frequency between f_0 and $4f_0$ for which $A_{H/V}(f^+) < A_0/2$
$\sigma_A(f)$	standard deviation of $A_{H/V}(f)$, $\sigma_A(f)$ is the factor by which the mean $A_{H/V}(f)$ curve should be multiplied or divided
$\sigma_{\log H/V}(f)$	standard deviation of $\log A_{H/V}(f)$ curve
$\theta(f_0)$	threshold value for the stability condition $\sigma_A(f) < \theta(f_0)$

Threshold values for σ_f and $\sigma_A(f_0)$

Freq. range [Hz]	< 0.2	0.2 – 0.5	0.5 – 1.0	1.0 – 2.0	> 2.0
$\varepsilon(f_0)$ [Hz]	$0.25 f_0$	$0.2 f_0$	$0.15 f_0$	$0.10 f_0$	$0.05 f_0$
$\theta(f_0)$ for $\sigma_A(f_0)$	3.0	2.5	2.0	1.78	1.58
$\log \theta(f_0)$ for $\sigma_{\log H/V}(f_0)$	0.48	0.40	0.30	0.25	0.20

Prova Array 2D - GAM_ESAC1



Committente: Dott. Geol. Carlo Copioli

Cantiere: MS3 Comune di Gambettola

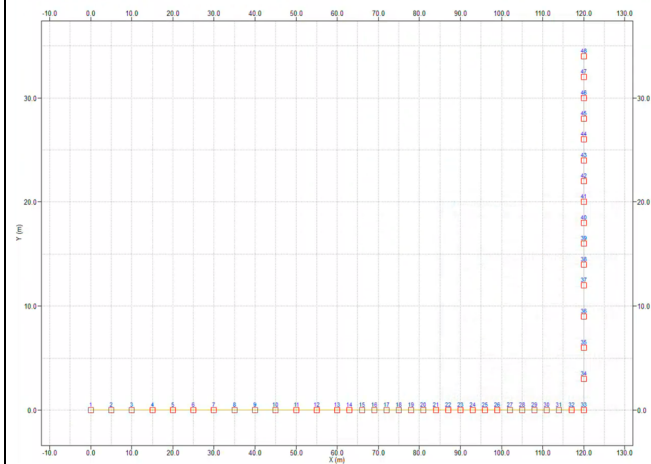
Località: Gambettola (FC)

Data: 23/07/2024

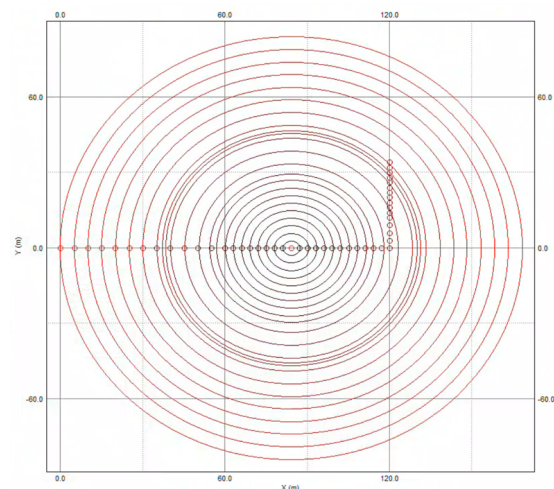
Coordinate UTM (WGS84-33N) profilo Vs: 286812 m E - 4887157 m N

GEOMETRIA ARRAY ESAC 48 ch

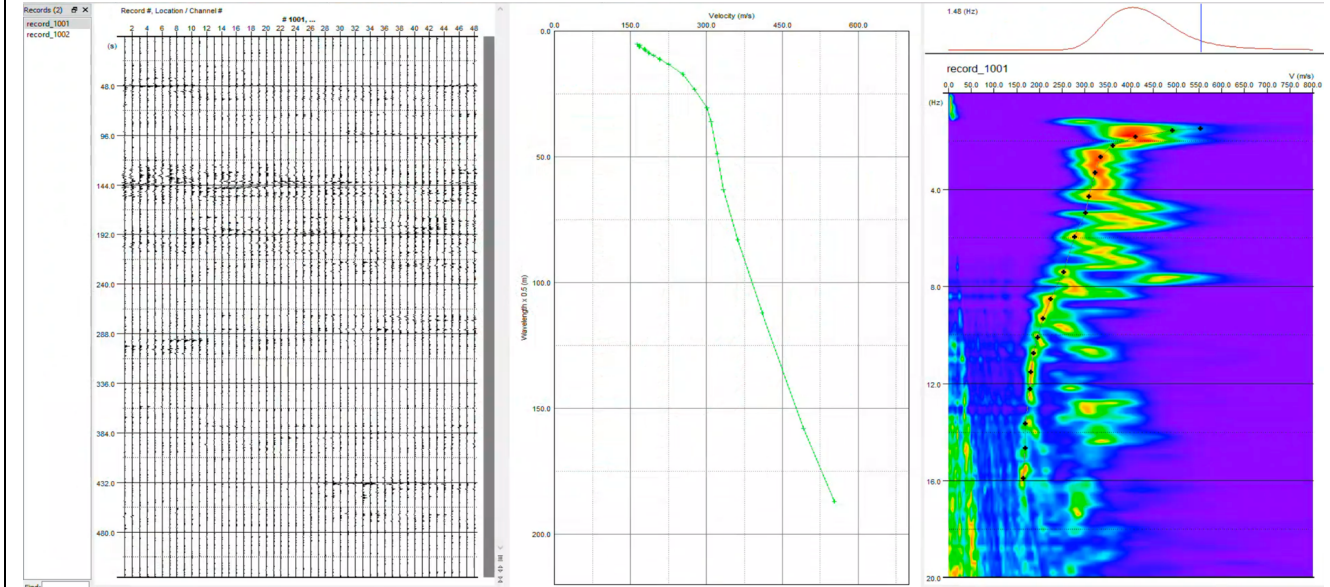
GAM ESAC 1 - 2D Geometry



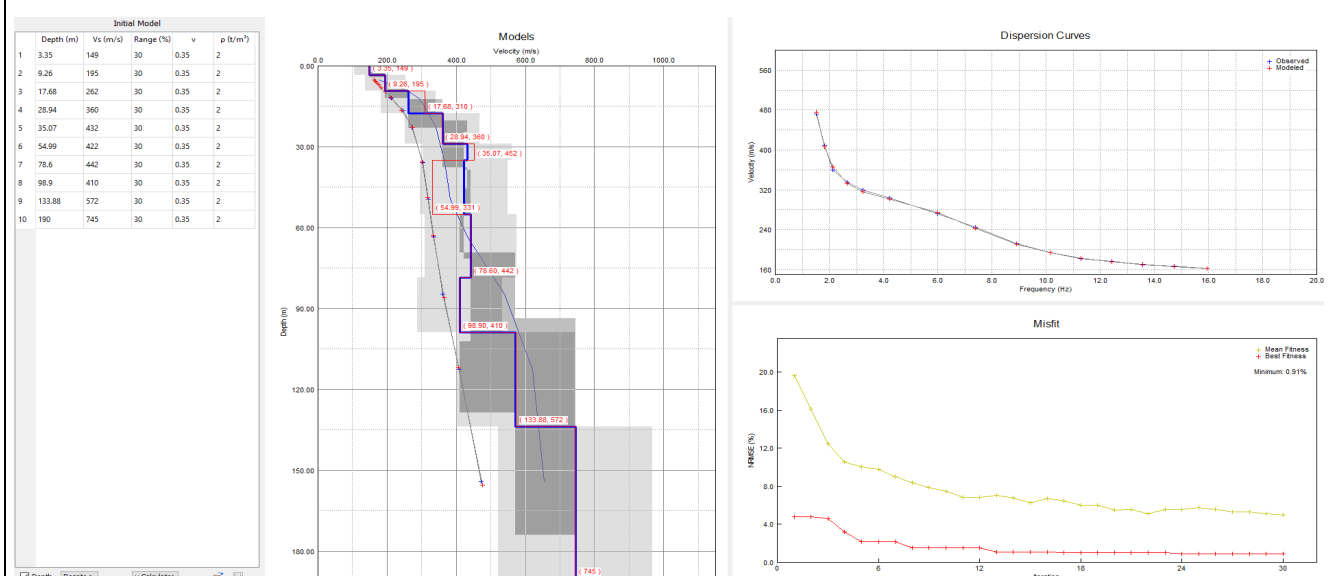
ESAC ARRAY QC 48 ch

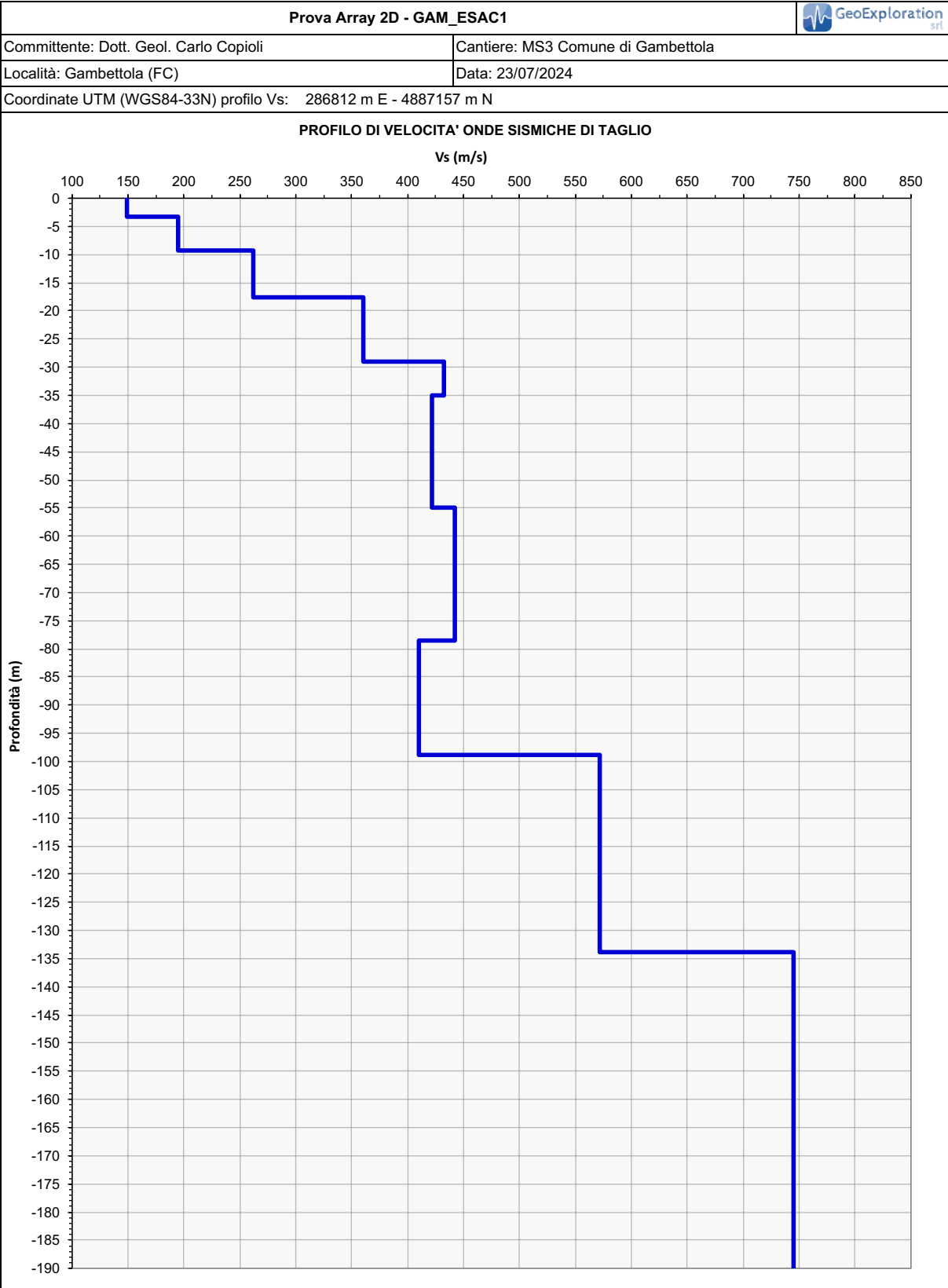


CURVA DI DISPERSIONE E PICKING F-V - ESAC



PROCESSO DI INVERSIONE DATI ESAC





MODELLO FINALE VS			
STRATO (N)	SPESSORE (H, m)	PROFONDITA' (m)	VS (m/s)
1	3,4	3,4	149
2	5,9	9,3	195
3	8,4	17,7	262
4	11,3	28,9	360
5	6,1	35,1	432
6	19,9	55,0	422
7	23,6	78,6	442
8	20,3	98,9	410
9	35,0	133,9	572
10	56,1	190,0	745

CALCOLO PARAMETRO VS30 (VSeq)

$$V_{s,eq} = \frac{H}{\sum_{strato=1}^N \frac{h(strato)}{V_s(strato)}}$$

Vs30 = 253

CLASSIFICAZIONE SISMICA DEI SUOLI (NTC2018)

Cat. C - Depositi di terreni a grana grossa mediamente addensati o terreni a grana fina mediamente consistenti con profondità del substrato superiori a 30 m, caratterizzati da un miglioramento delle proprietà meccaniche con la profondità e da valori di velocità equivalente compresi tra 180 m/s e 360 m/s

Prova Array 2D - GAM_ESAC2



Committente: Dott. Geol. Carlo Copioli

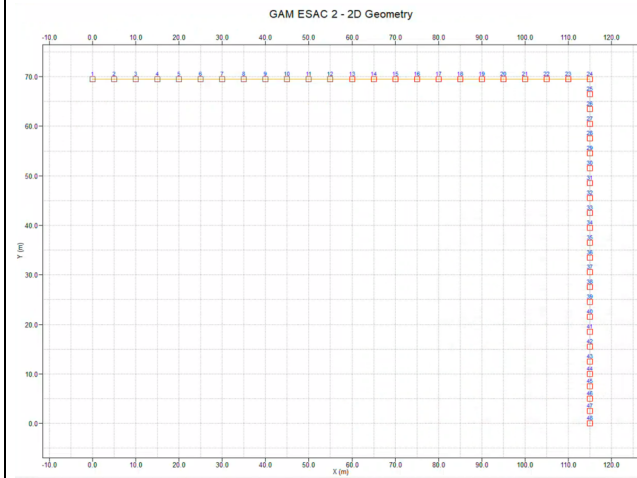
Cantiere: MS3 Comune di Gambettola

Località: Gambettola (FC)

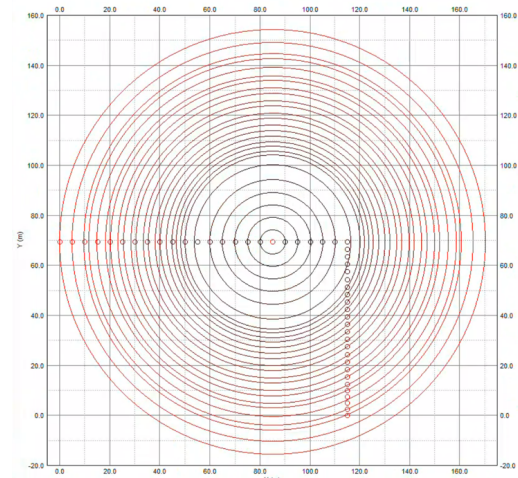
Data: 23/07/2024

Coordinate UTM (WGS84-33N) profilo Vs: 286611 m E - 4888535 m N

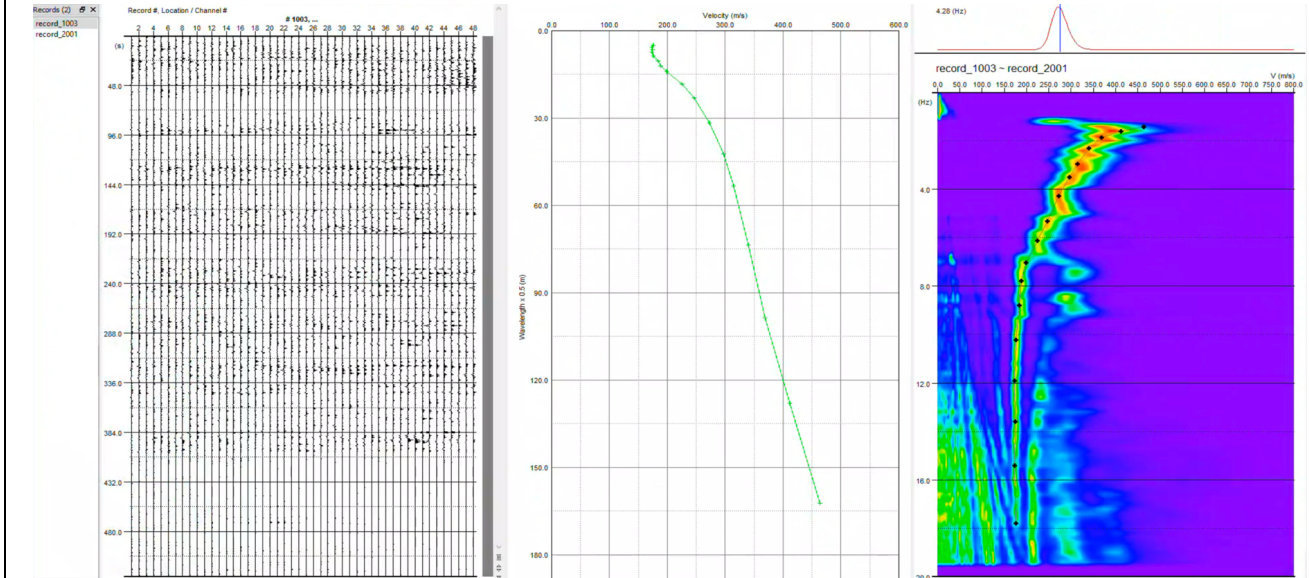
GEOMETRIA ARRAY ESAC 48 ch



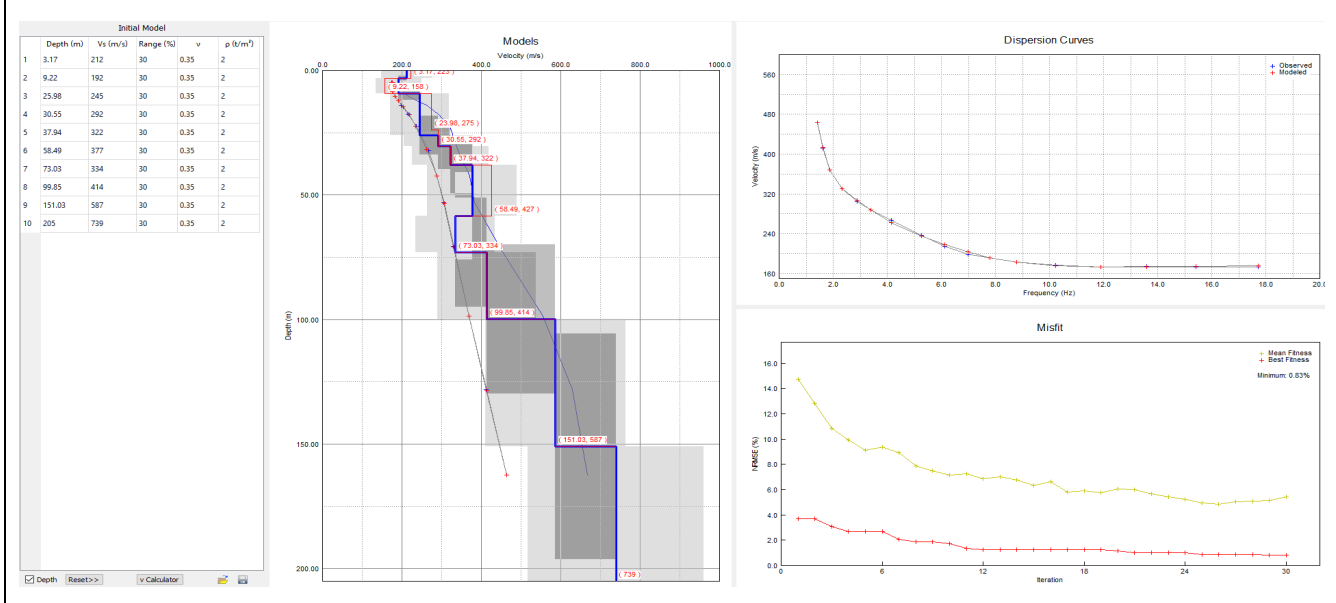
ESAC ARRAY QC 48 ch

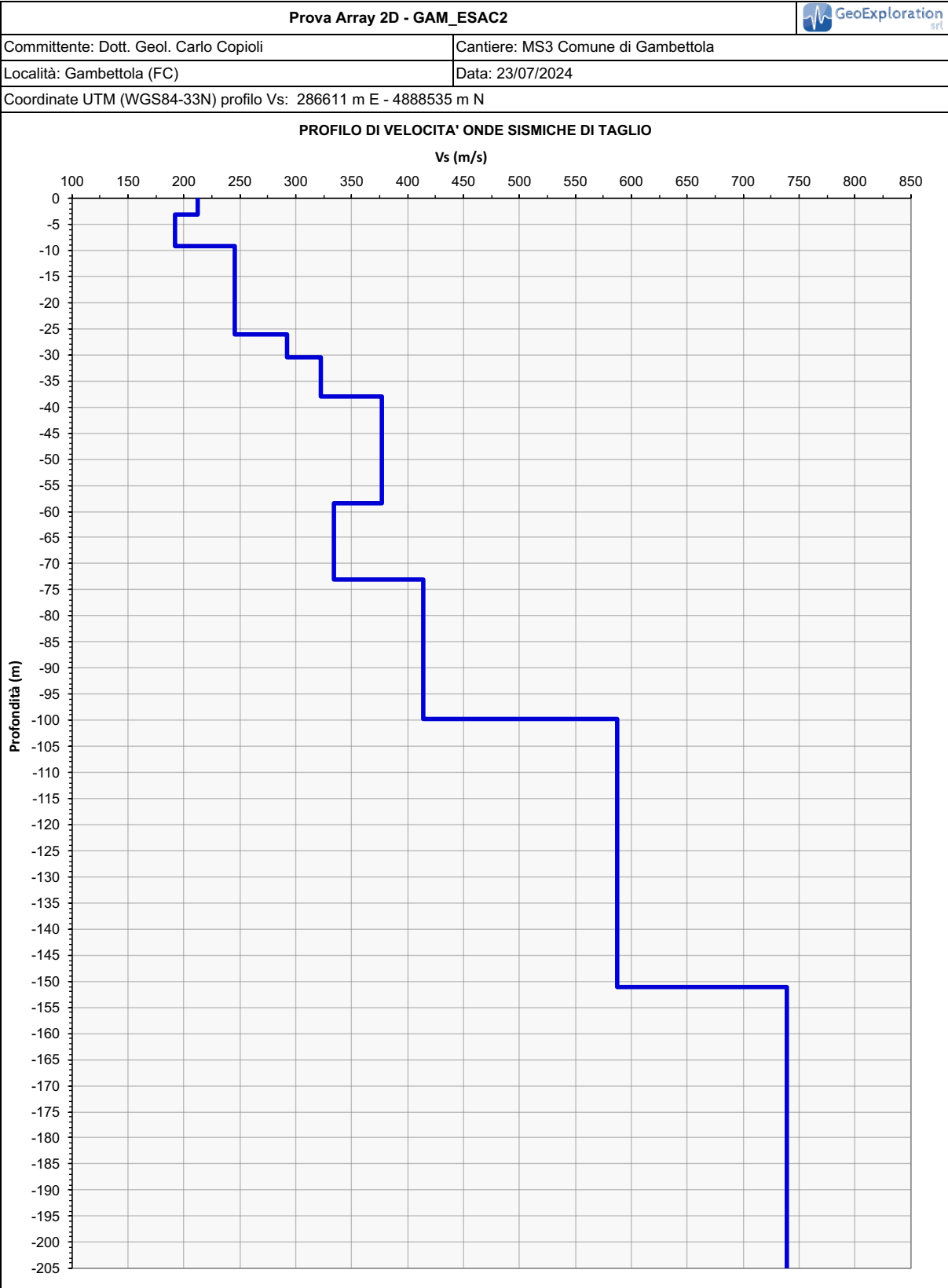


CURVA DI DISPERSIONE E PICKING F-V - ESAC



PROCESSO DI INVERSIONE DATI ESAC





MODELLO FINALE VS			
STRATO (N)	SPESSORE (H, m)	PROFONDITA' (m)	VS (m/s)
1	3,2	3,2	212
2	6,1	9,2	192
3	16,8	26,0	245
4	4,6	30,6	292
5	7,4	37,9	322
6	20,6	58,5	377
7	14,5	73,0	334
8	26,8	99,9	414
9	51,2	151,0	587
10	54,0	205,0	739

CALCOLO PARAMETRO VS30 (VSeq)

$$V_{s,eq} = \frac{H}{\sum_{strato=1}^N \frac{h(strato)}{V_s(strato)}}$$

Vs30

=

233

CLASSIFICAZIONE SISMICA DEI SUOLI (NTC2018)

Cat. C - Depositi di terreni a grana grossa mediamente addensati o terreni a grana fina mediamente consistenti con profondità del substrato superiori a 30 m, caratterizzati da un miglioramento delle proprietà meccaniche con la profondità e da valori di velocità equivalente compresi tra 180 m/s e 360 m/s

Prova Array 2D - GAM_ESAC3



Committente: Dott. Geol. Carlo Copioli

Cantiere: MS3 Comune di Gambettola

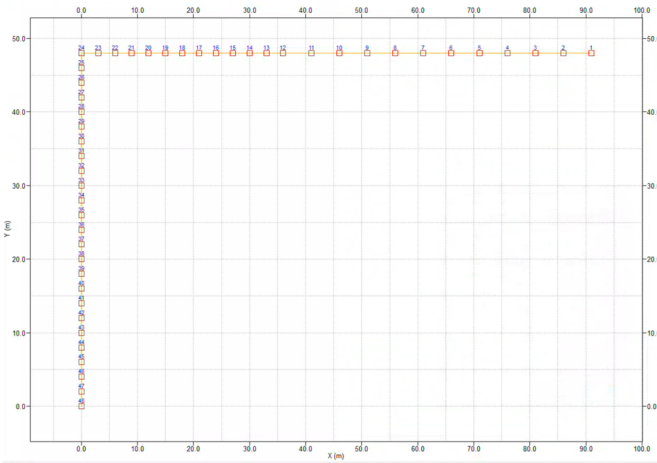
Località: Gambettola (FC)

Data: 23/07/2024

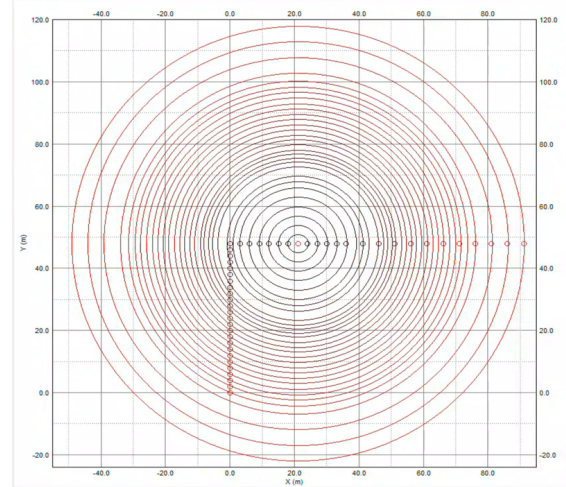
Coordinate UTM (WGS84-33N) profilo Vs: 287657 m E - 4888760 m N

GEOMETRIA ARRAY ESAC 48 ch

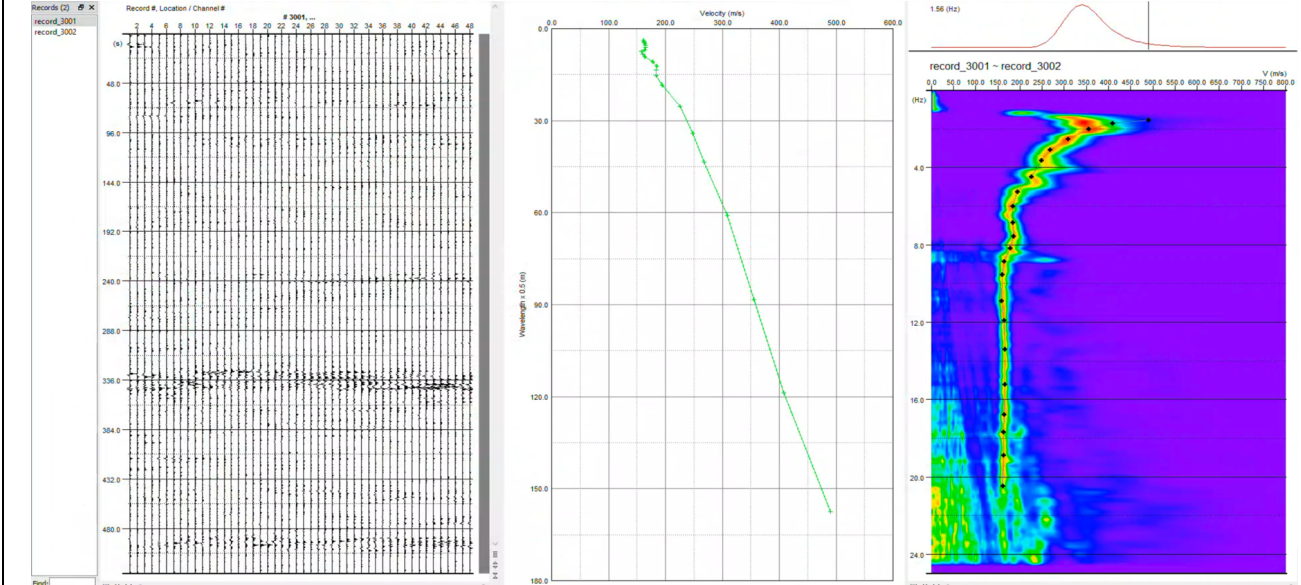
GAM ESAC 3 - 2D Geometry



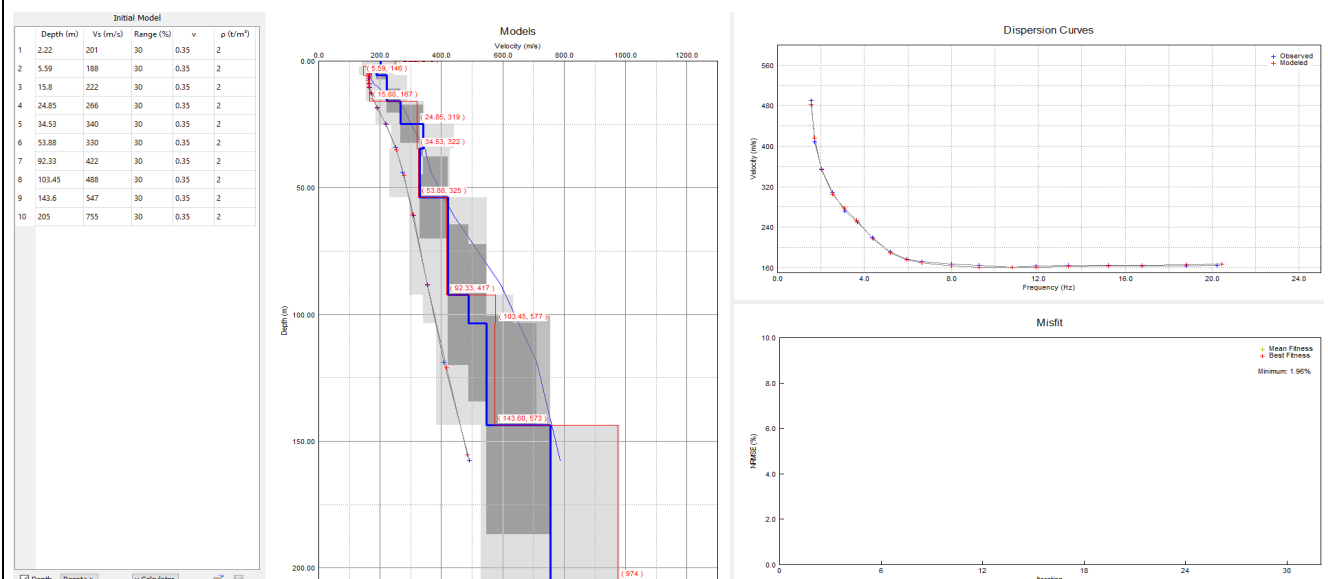
ESAC ARRAY QC 48 ch

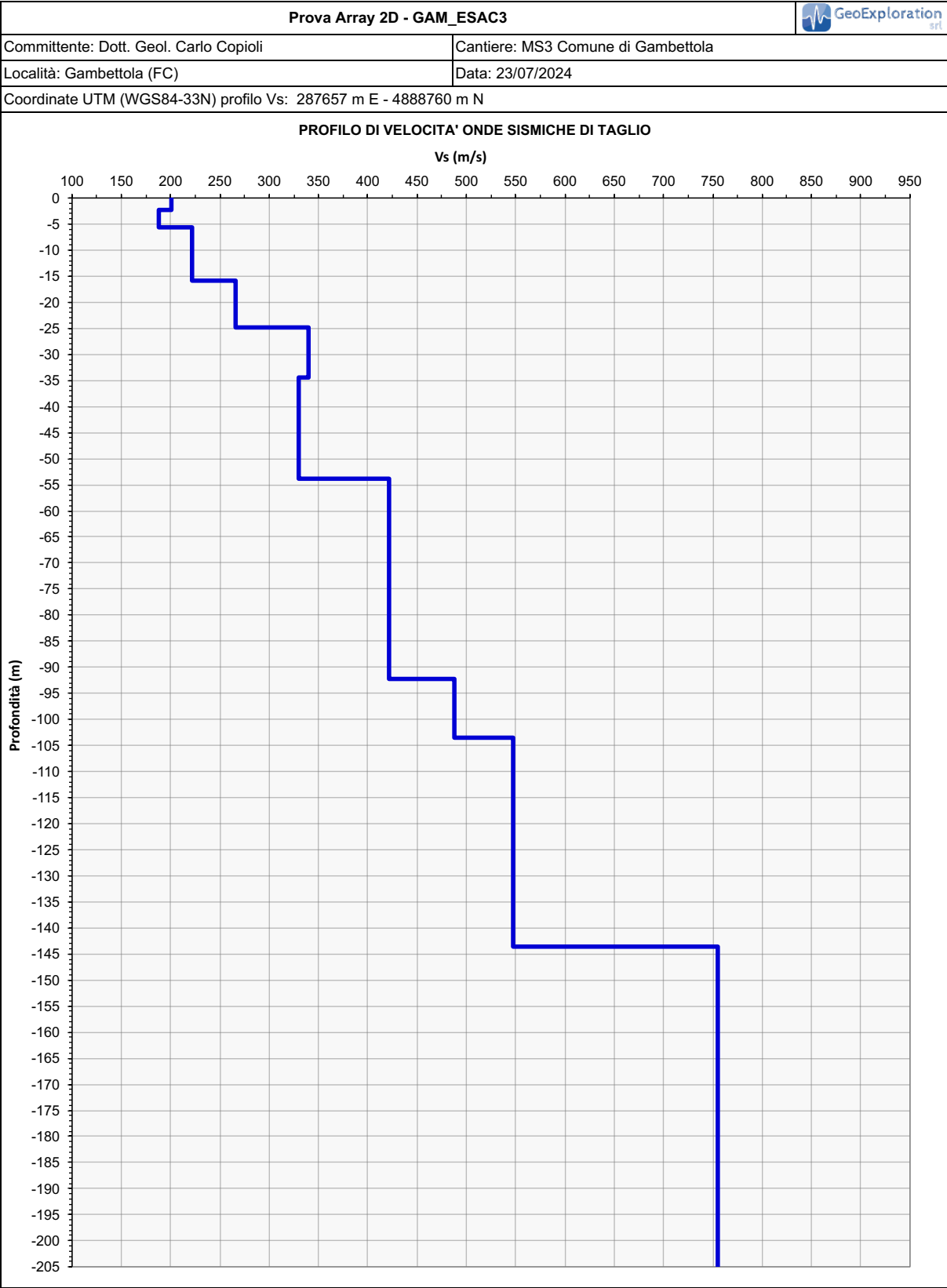


CURVA DI DISPERSIONE E PICKING F-V - ESAC



PROCESSO DI INVERSIONE DATI ESAC





MODELLO FINALE VS			
STRATO (N)	SPESSORE (H, m)	PROFONDITA' (m)	VS (m/s)
1	2,2	2,2	201
2	3,4	5,6	188
3	10,2	15,8	222
4	9,1	24,9	266
5	9,7	34,5	340
6	19,4	53,9	330
7	38,5	92,3	422
8	11,1	103,5	488
9	40,2	143,6	547
10	61,4	205,0	755

CALCOLO PARAMETRO VS30 (VSeq)

$$V_{s,eq} = \frac{H}{\sum_{strato=1}^N \frac{h(strato)}{V_s(strato)}}$$

Vs30

=

242

CLASSIFICAZIONE SISMICA DEI SUOLI (NTC2018)

Cat. C - Depositi di terreni a grana grossa mediamente addensati o terreni a grana fina mediamente consistenti con profondità del substrato superiori a 30 m, caratterizzati da un miglioramento delle proprietà meccaniche con la profondità e da valori di velocità equivalente compresi tra 180 m/s e 360 m/s