



**MICROZONAZIONE SISMICA
DELLA CONCA AQUILANA
(terremoto 06-04-2009)**

Relazione tecnica finale di sintesi - Macroarea 9

**ALLEGATO 8 - PROVE MASW E SISMICA
PASSIVA (REMI)**

ReMi

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Strumentazione impiegata e metodologia d'indagine

Nella macroarea 9 sono state effettuate 30 indagini ReMi in prossimità dei nuclei abitati che fanno parte di questa macroarea.

Nella quasi totalità dei punti di indagine ReMi, con finalità di ausilio nella fase di inversione monodimensionale sono state realizzate singole misure di rumore sismico con la determinazione del rapporto H/V; inoltre in corrispondenza di alcune misure, ed utilizzando il medesimo array sono state effettuate indagini MASW sempre con la finalità di acquisire ulteriori informazioni a conforto della fase di modellazione.

Operativamente sono stati realizzati stendimenti utilizzando un acquisitore digitale RAS24 a 24 canali con dinamica a 24 bit e geofoni da 4.5 Hz; il tempo di ascolto è stato pari a 30 secondi per ciascuna acquisizione (per 8/9 complessive), con un intervallo di campionamento di 2 ms.

L'intervallo intergeofonico; è variato principalmente tra i 2 ai 3 m in quanto gli spazi a disposizione, trovandosi in prossimità o all'interno di nuclei abitati, non permettevano la realizzazione di array più estesi; ciò ha consentito inoltre di ridurre possibili effetti bidimensionali in quanto la maggior parte dei siti d'indagine si collocava su versante ma ha limitato la profondità d'indagine.

I passi del processo elaborativo sono i seguenti:

- trasformazione dei formati dei dati
- preprocessing dei dati
- calcolo della trasformata p-f per ogni record
- picking per la costruzione della curva di dispersione
- calcolo del modello 1D delle Vs mediante inversione della curva di dispersione.

Per la fase di l'elaborazione dei dati è stato utilizzato un software dedicato denominato ReMi e prodotto dalla Optim LLC.

La fase di modellazione è stata attuata utilizzando come ausilio e supporto i risultati delle analisi dei rapporti spettrali realizzata per mezzo dello strumento Tromino impiegando la nota formula semplificata $H = V_s/4f$ al fine di ottenere con entrambi gli approcci uno spessore (H) tra loro comparabile.

Le misure HVSR sono state tutte di lunghezza pari a 26 minuti e sono state analizzate con finestra di 20 secondi e smoothing pari al 5%.

Inoltre in alcuni casi utilizzando il medesimo array dell'indagine ReMi sono state eseguite alcune indagini MASW con differenti offset di energizzazione (1, 2, 3 * distanza intergeofonica) ciò sempre al fine di confrontare e guidare la fase di inversione delle indagini ReMi. La frequenza di campionamento è stata pari a 0.25 ms per un tempo di acquisizione di 1 s.



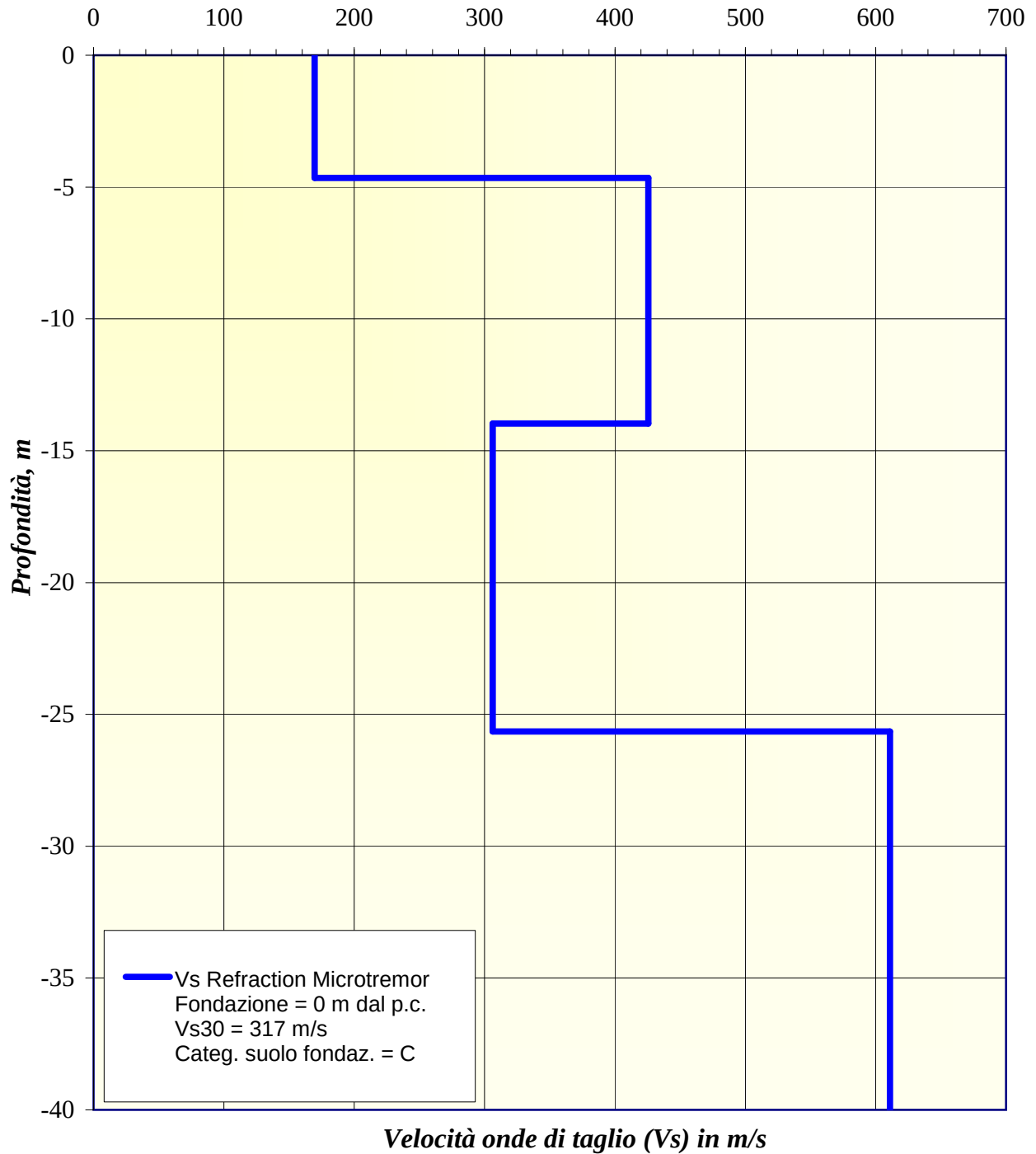
**MICROZONAZIONE SISMICA
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Relazione tecnica finale di sintesi - Macroarea 9

**PIANOLA - PROVE MASW E SISMICA
PASSIVA (REMI)**

Pianola1

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

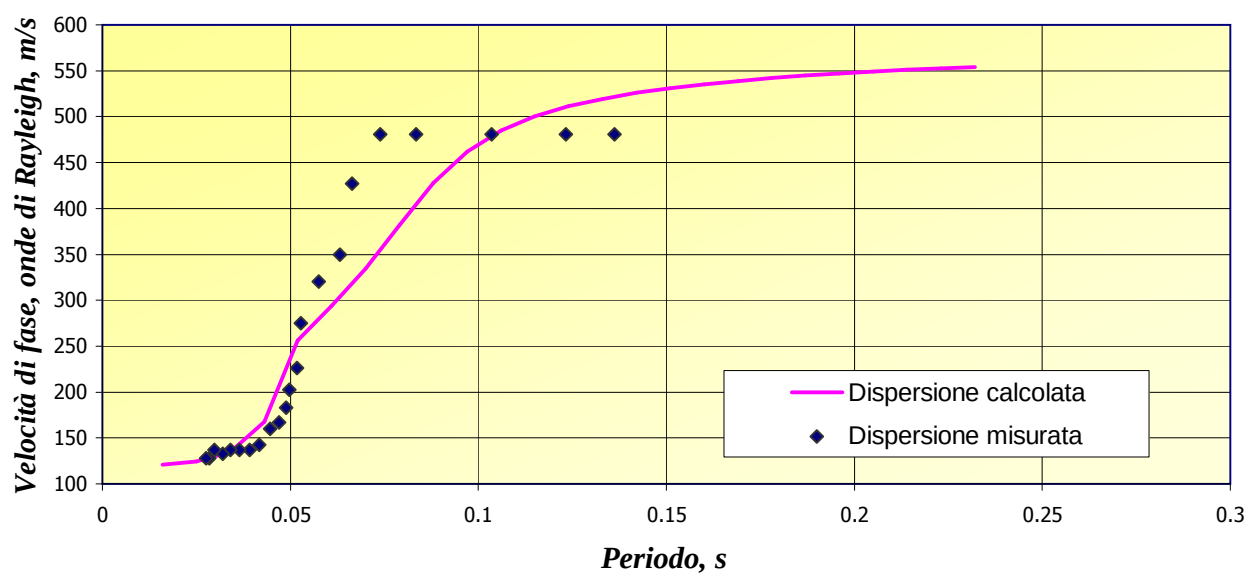
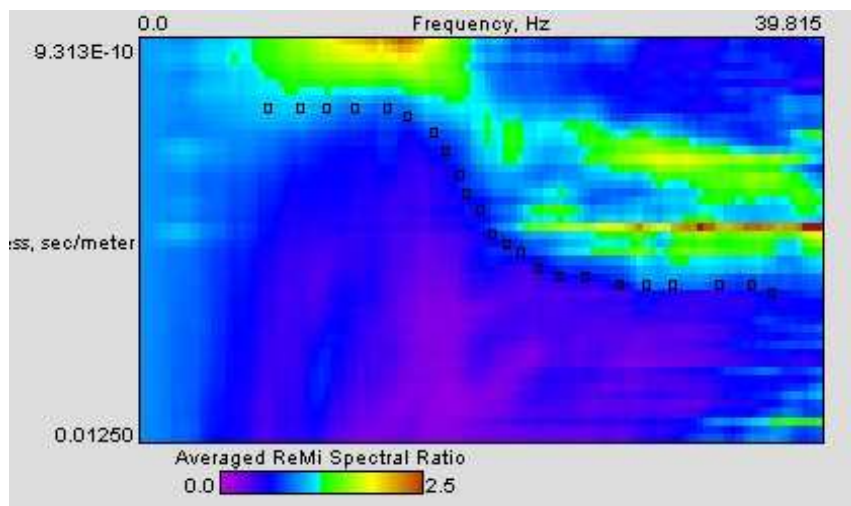
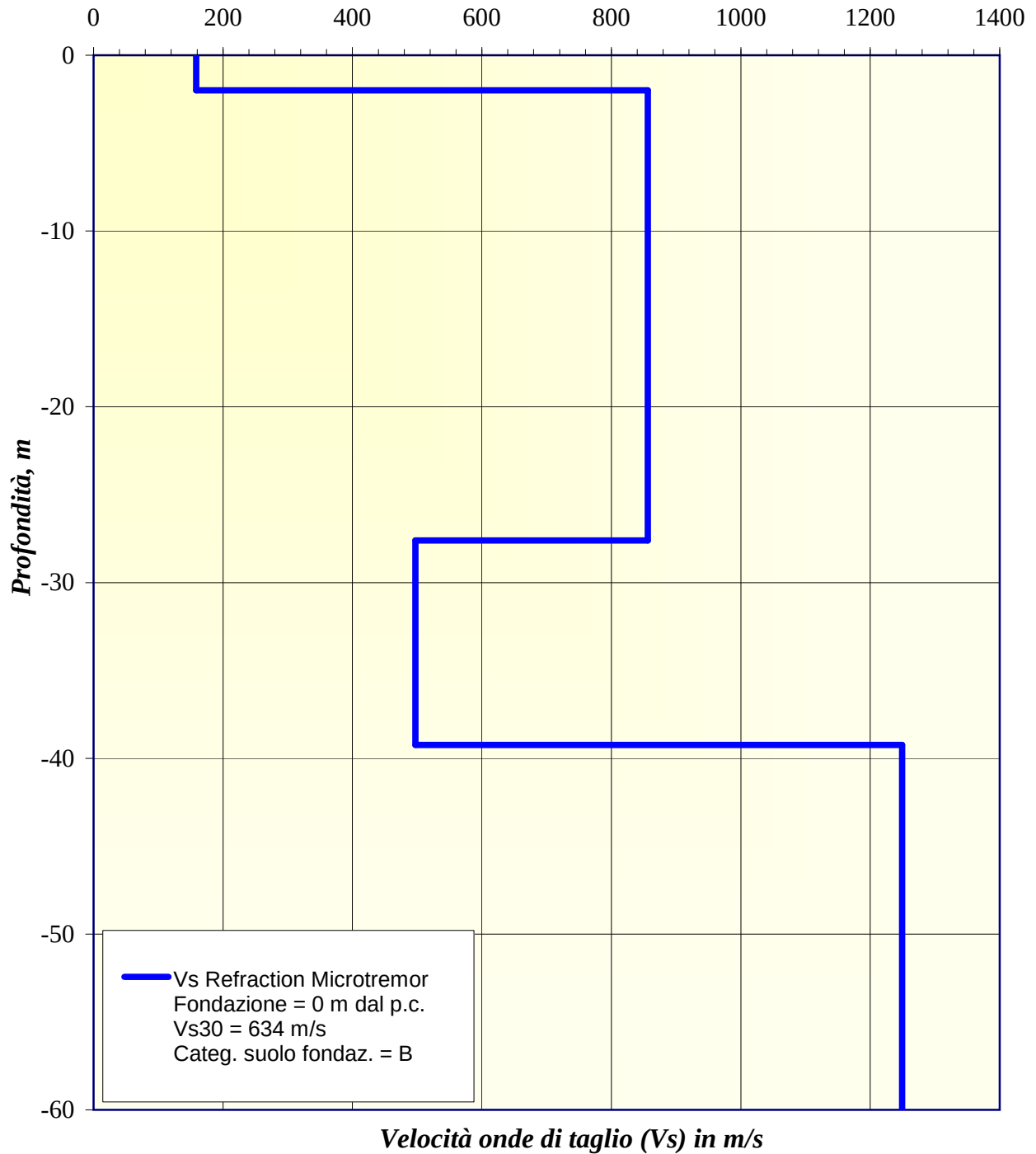


grafico slowness/frequenza



Pianola2

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

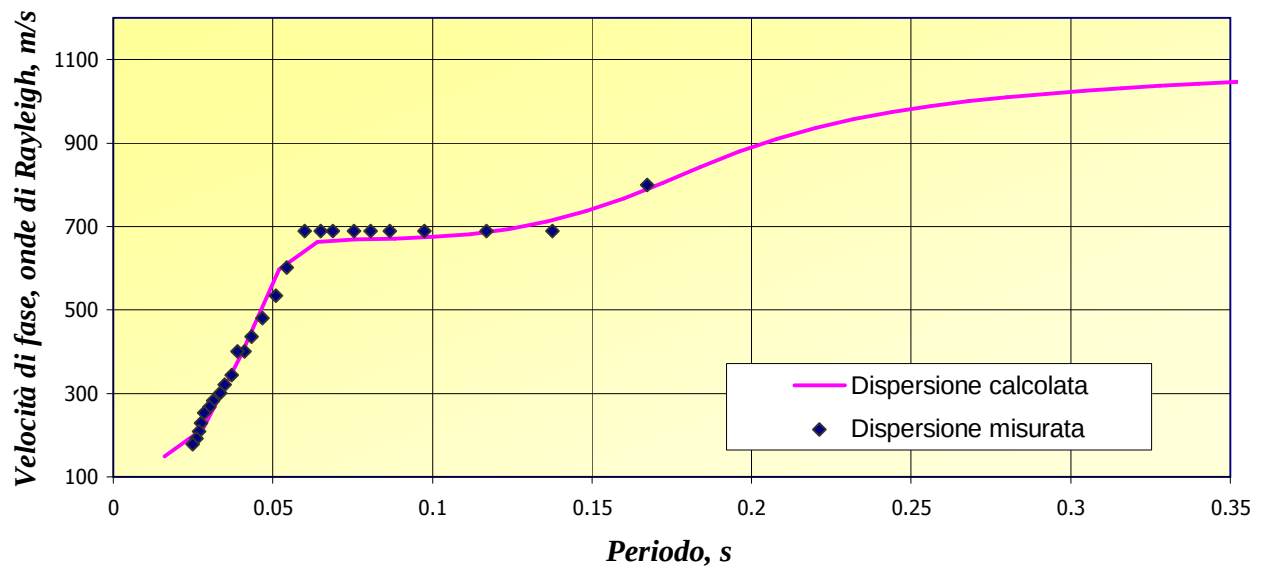
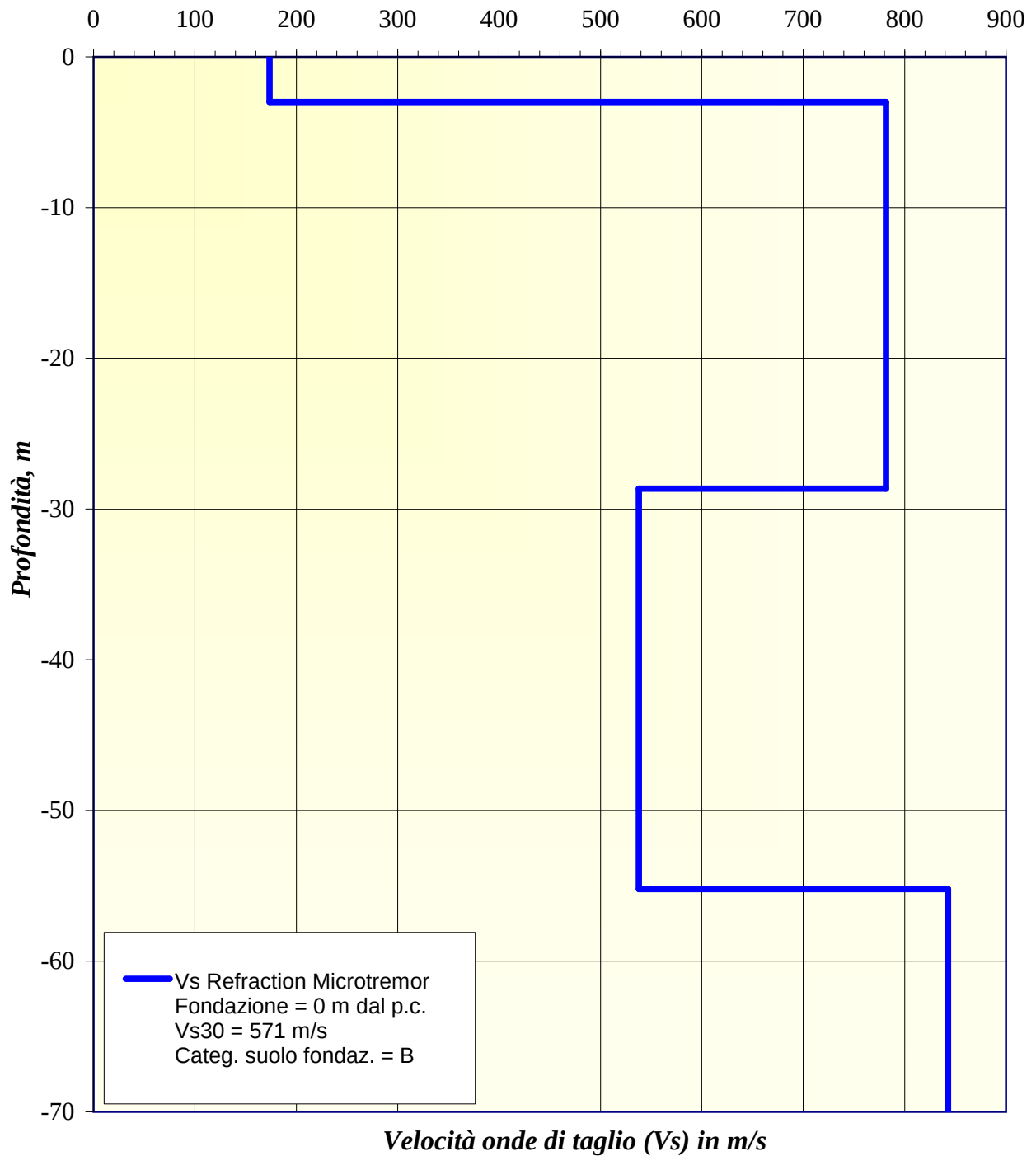


grafico slowness/frequenza

Pianola3

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

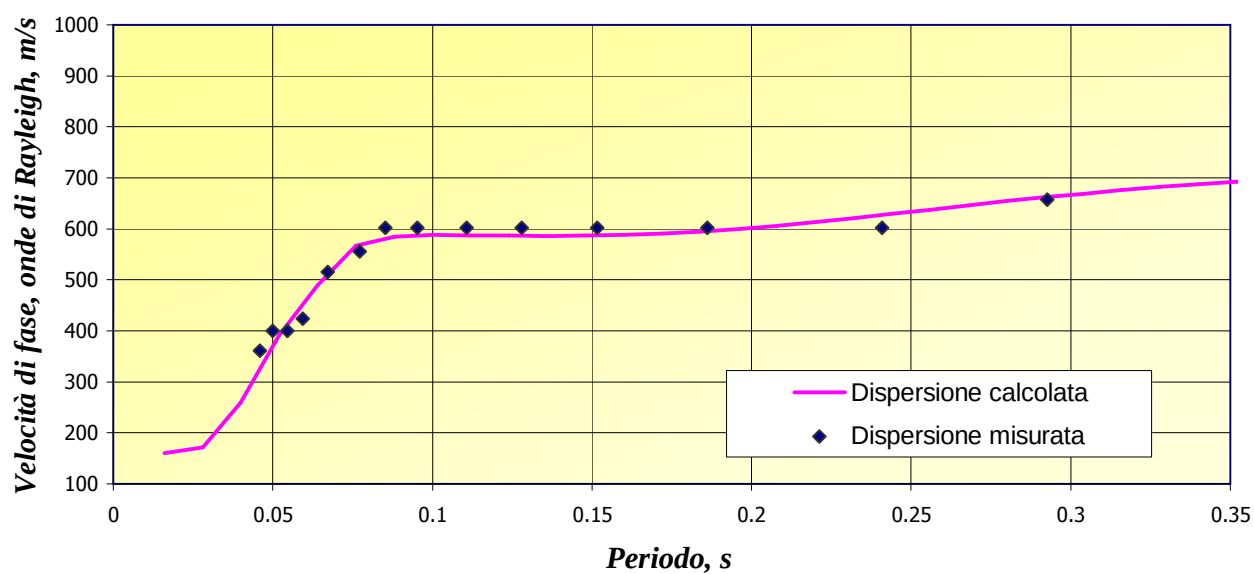
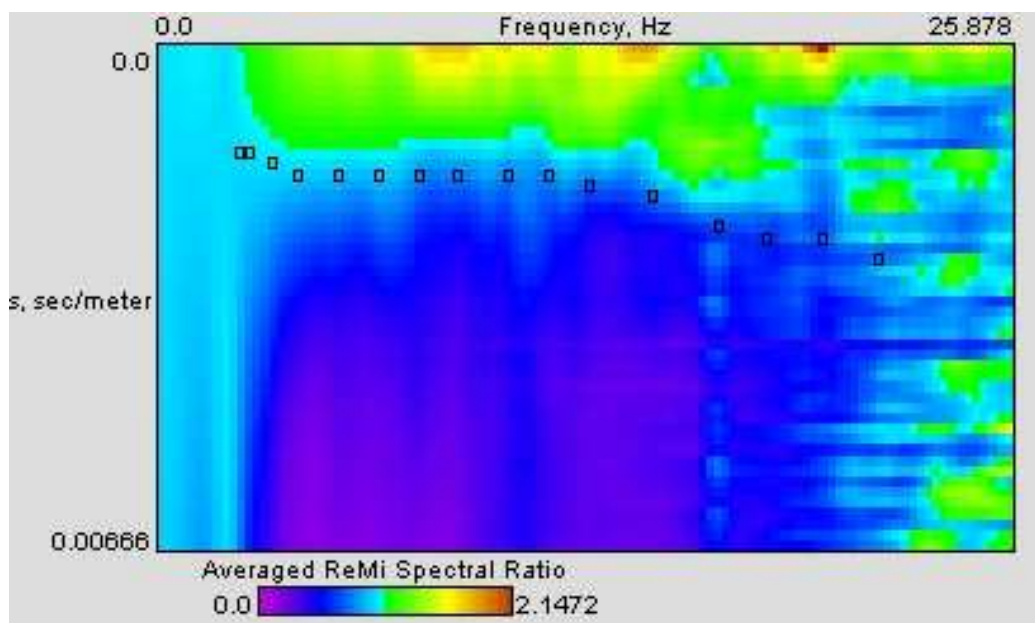
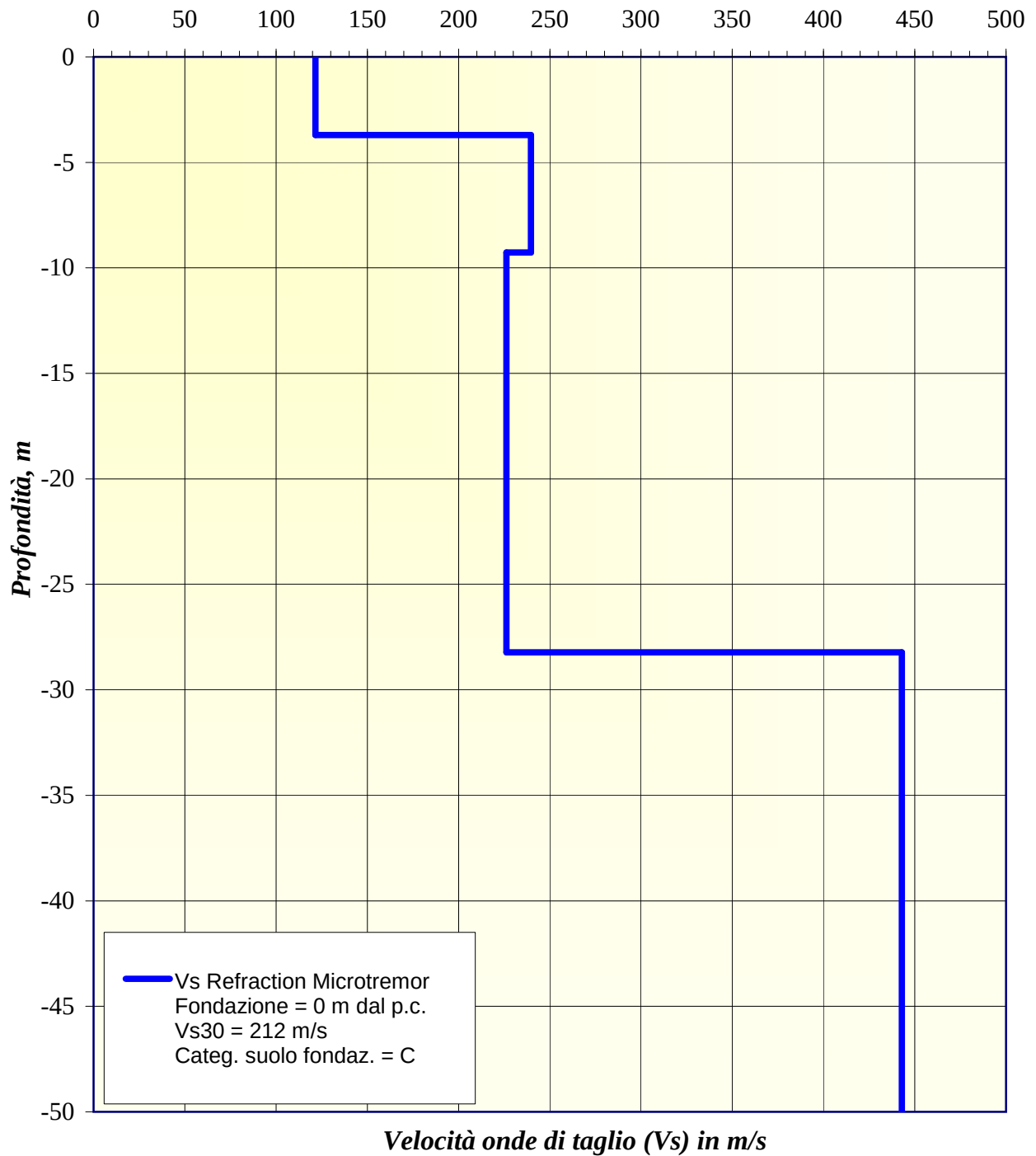


grafico slowness/frequenza



Pianola 4

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

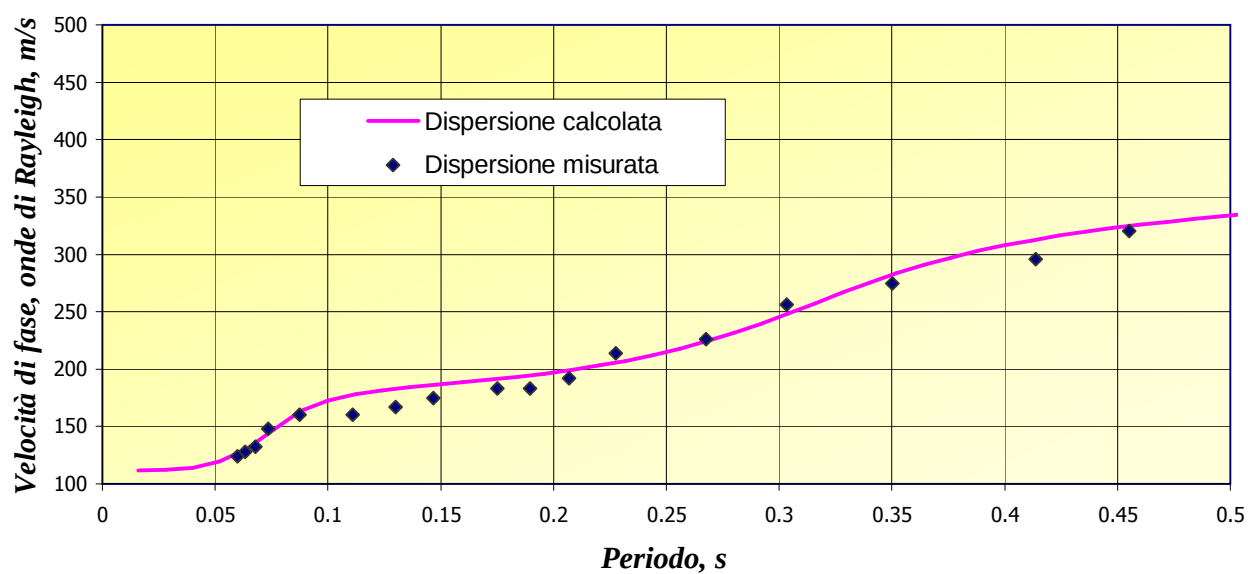
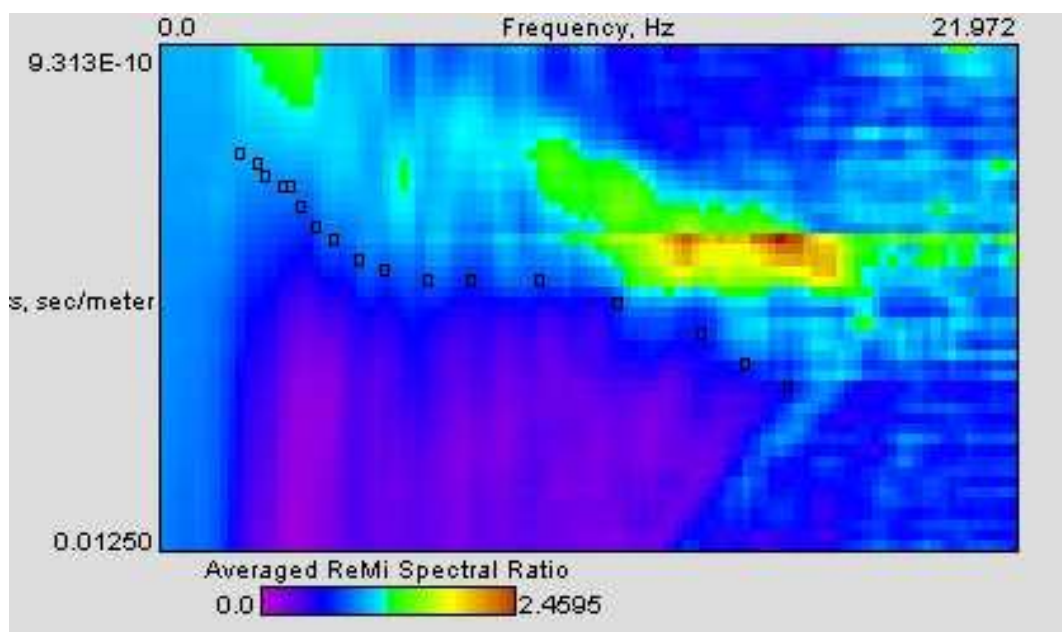
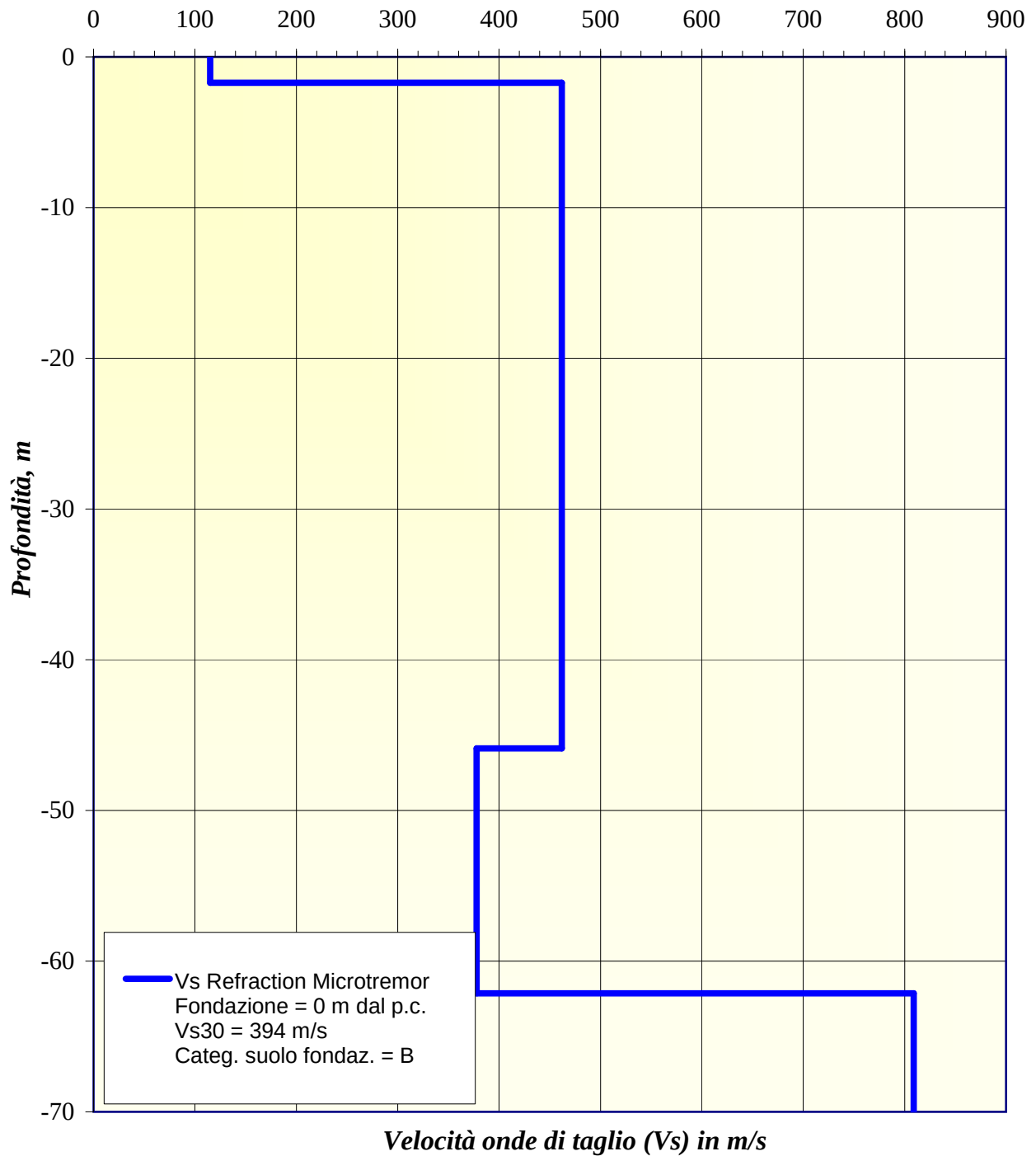


grafico slowness/frequenza



Pianola5

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

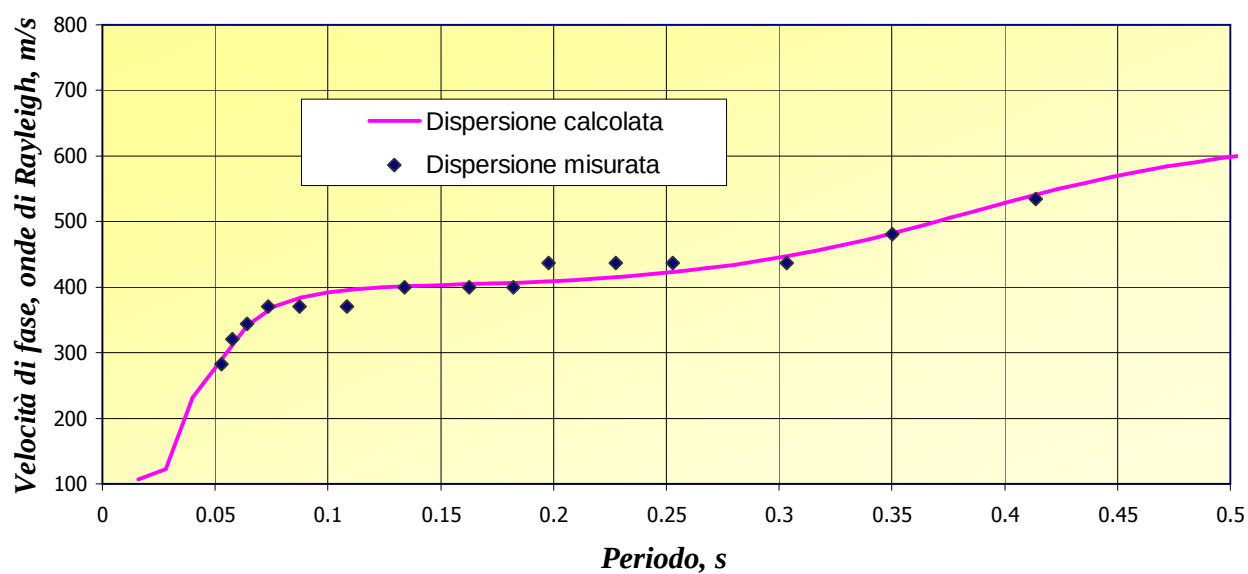
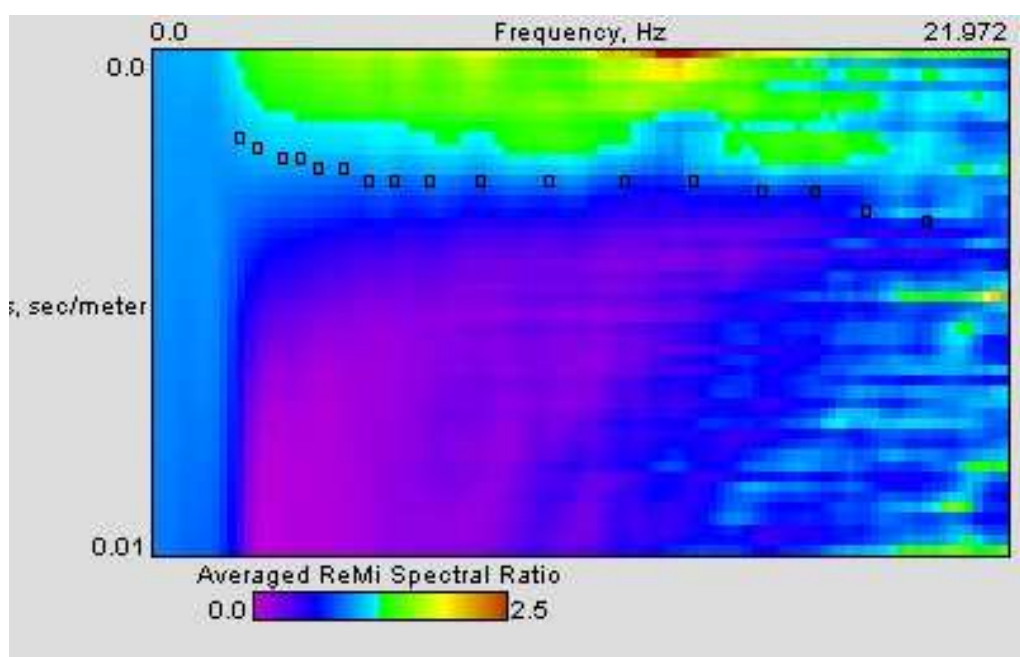
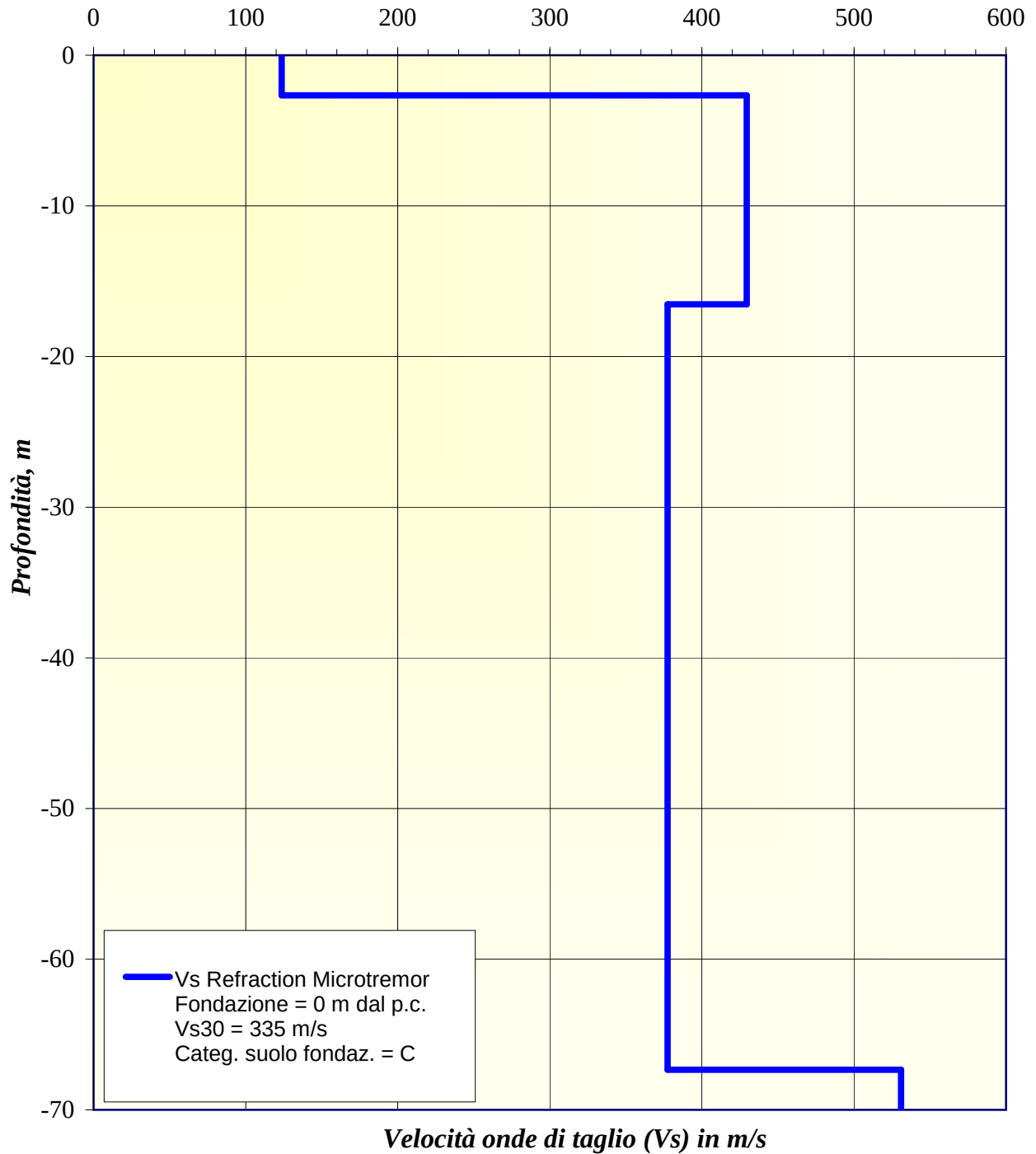


grafico slowness/frequenza



Pianola6

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

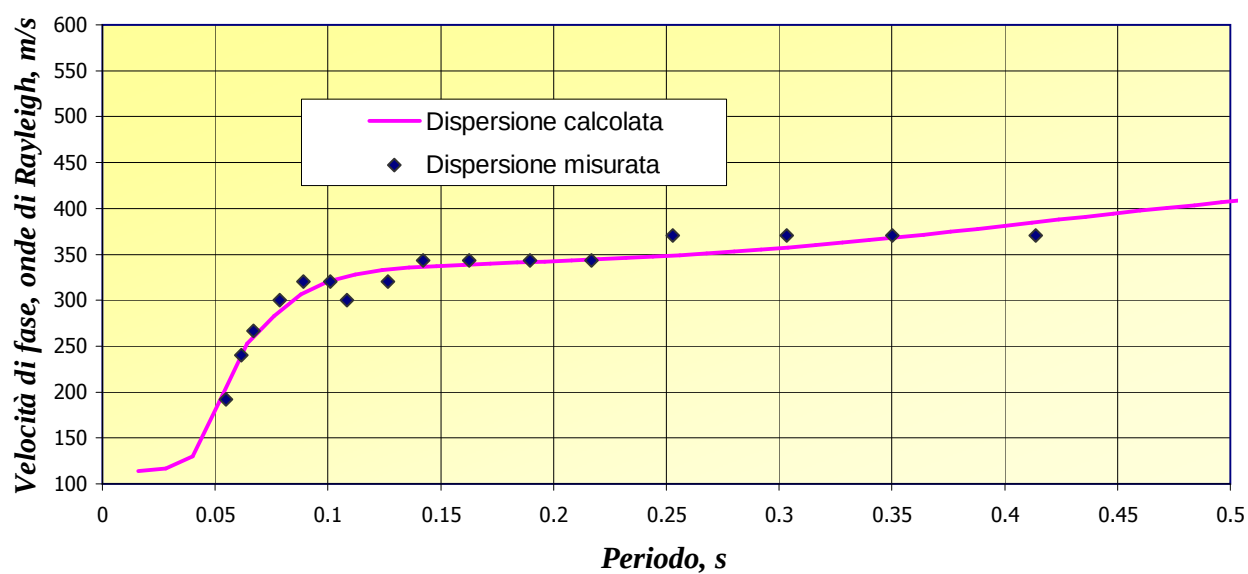
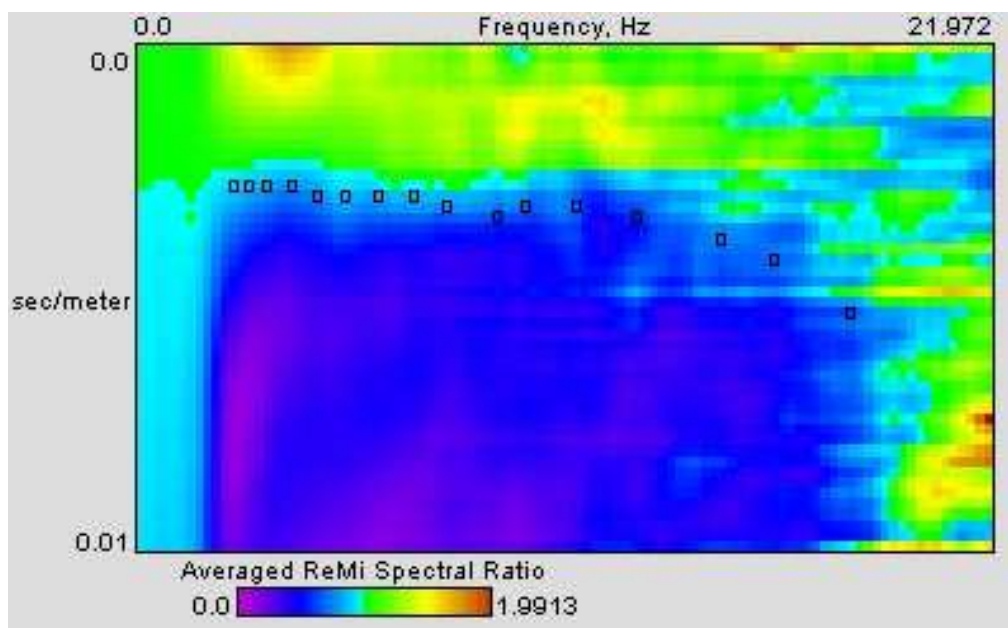
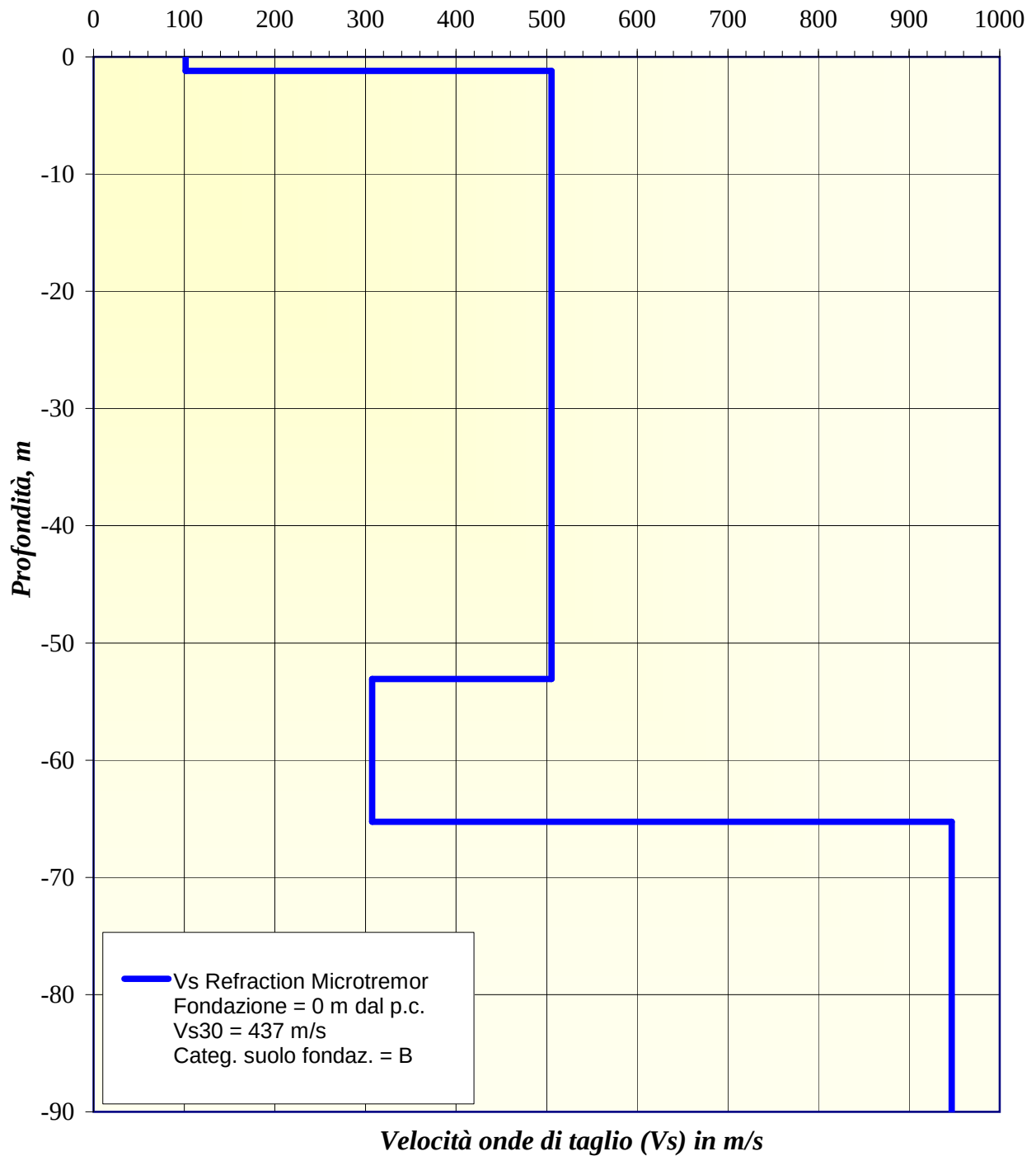


grafico slowness/frequenza



Pianola7

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

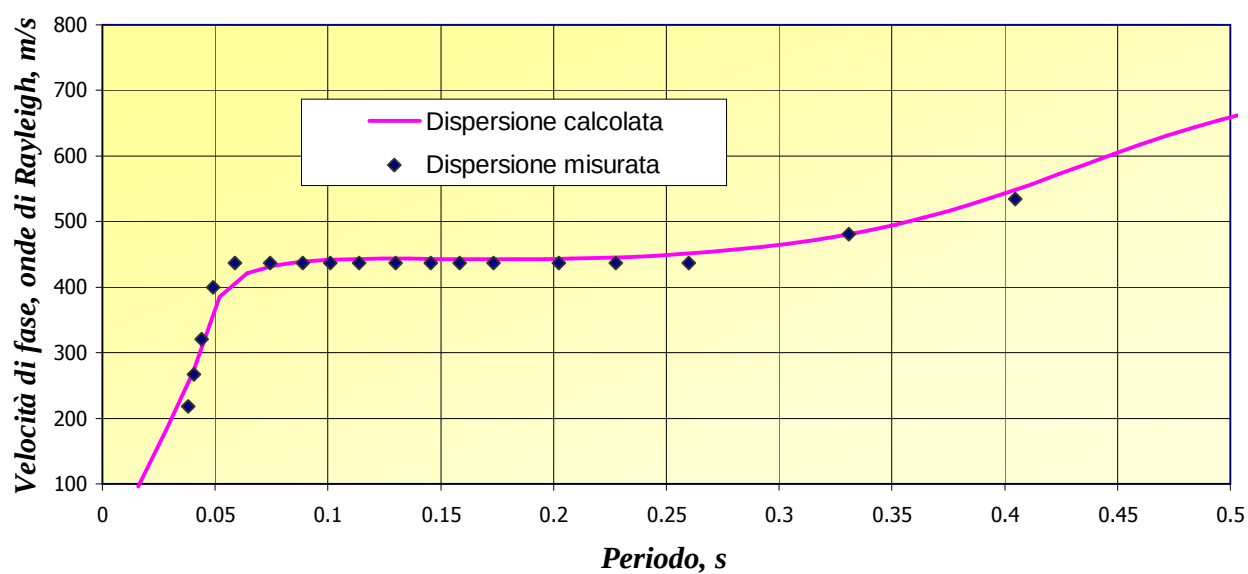
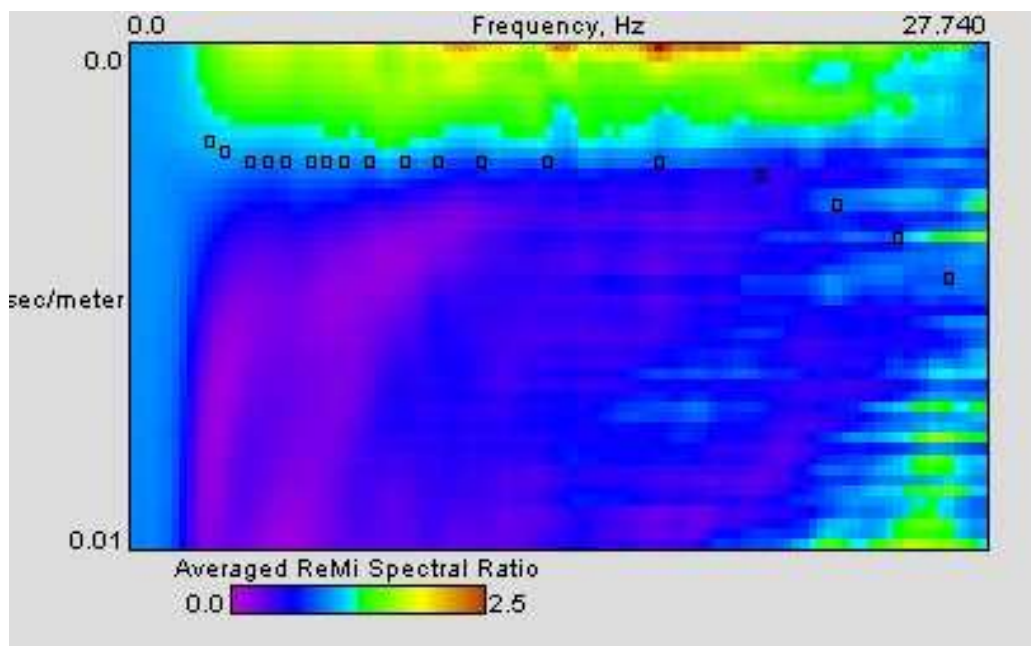
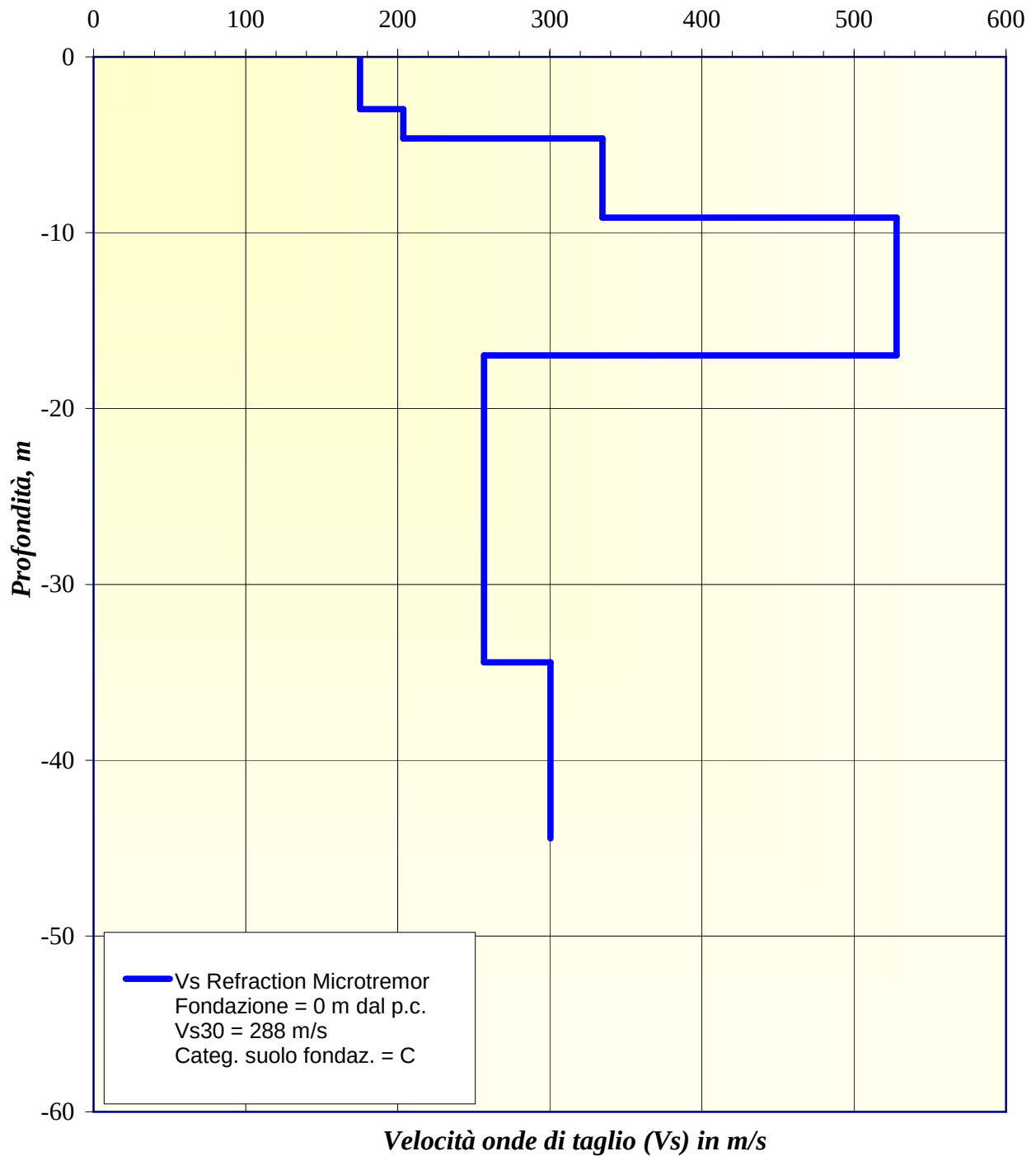


grafico slowness/frequenza



Pianola 43

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

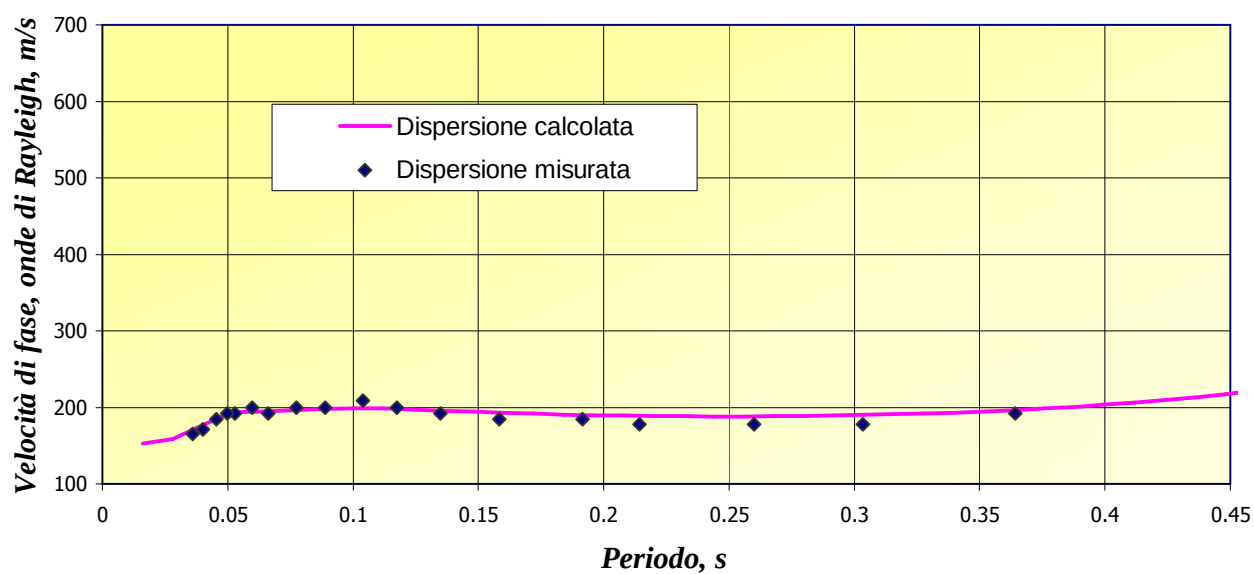
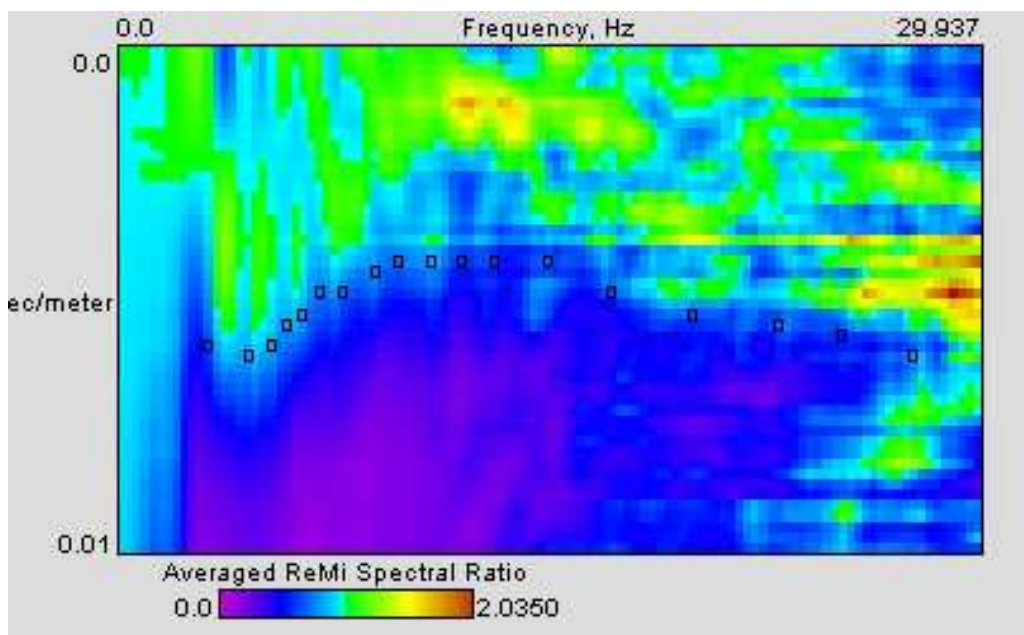
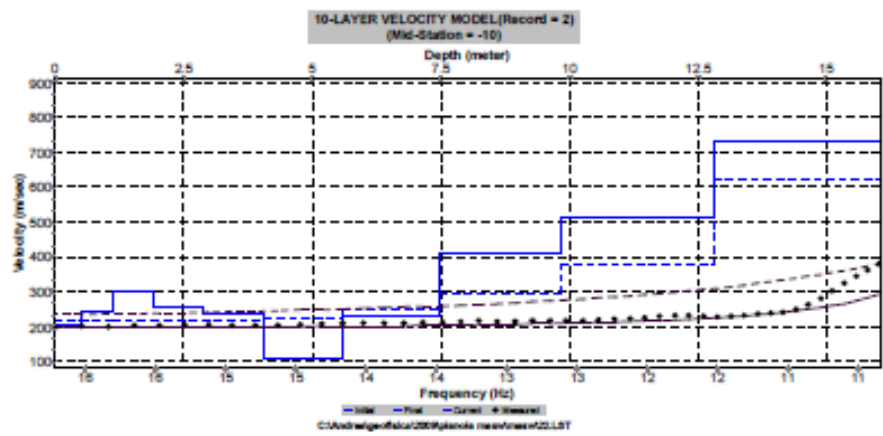


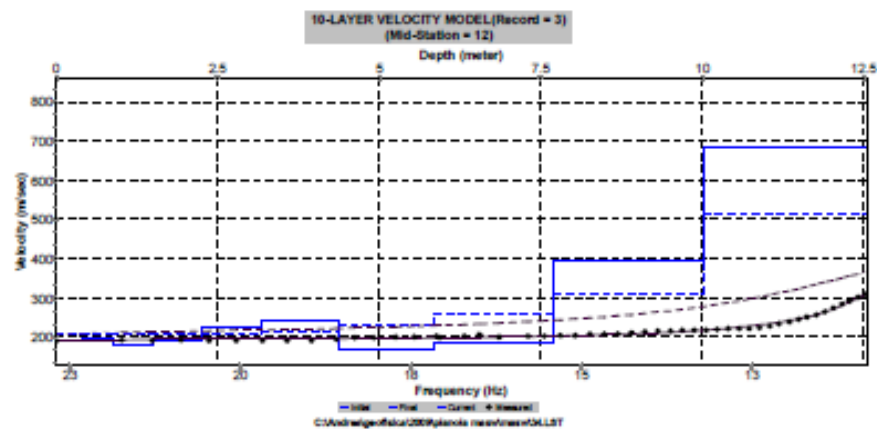
grafico slowness/frequenza



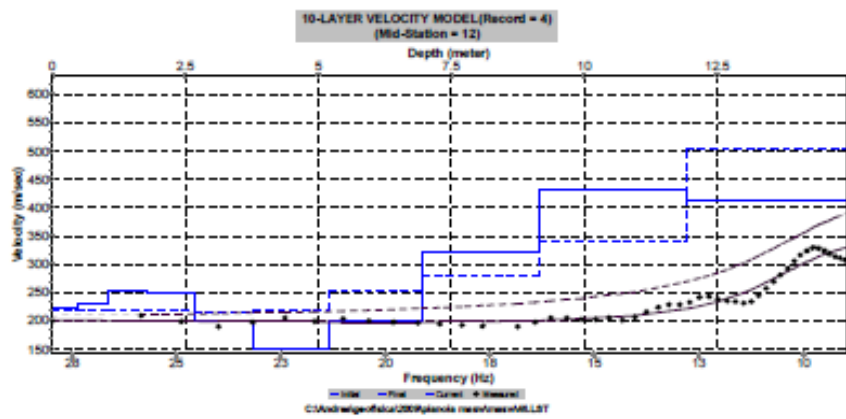
PIANOLA MASW 43



offset 2 m (spaziatura 2m)



offset 4 m (spaziatura 2m)



offset 6 m (spaziatura 2m)

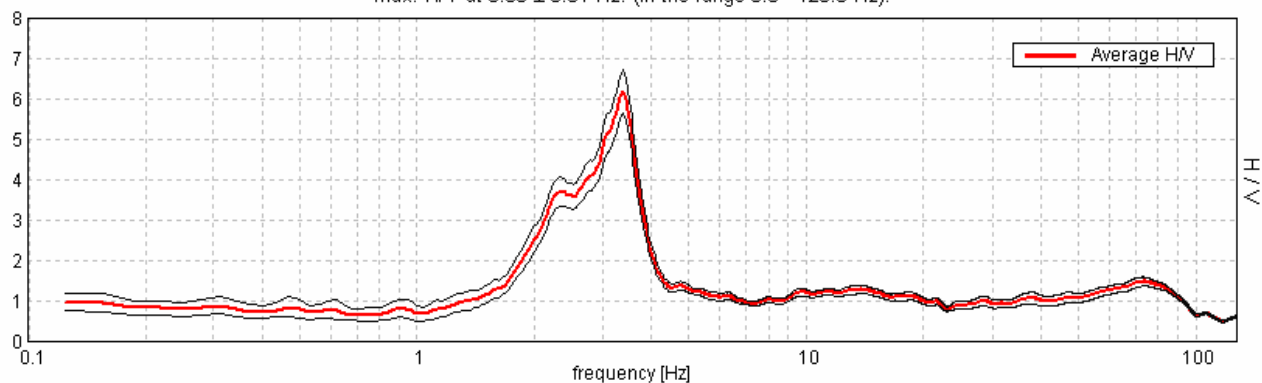
PIANOLA, 1

Start recording: 30/06/09 18:11:28 End recording: 30/06/09 18:39:29
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

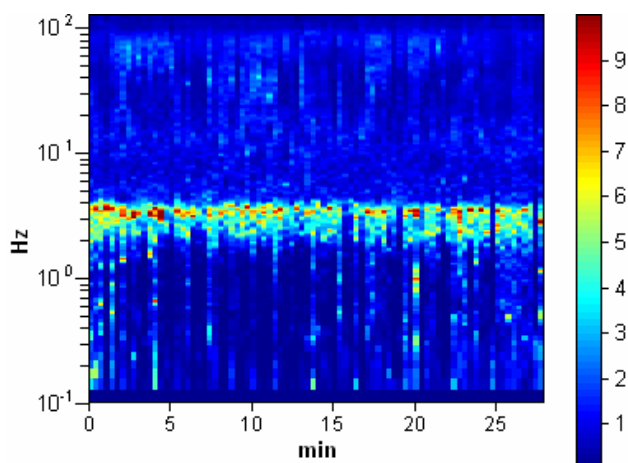
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

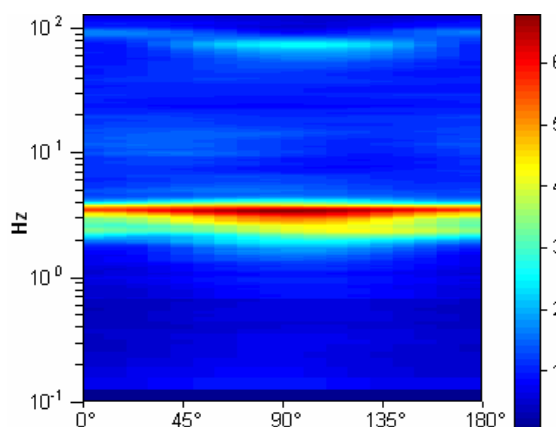
Max. H/V at 3.38 ± 0.01 Hz. (In the range 0.0 - 128.0 Hz).



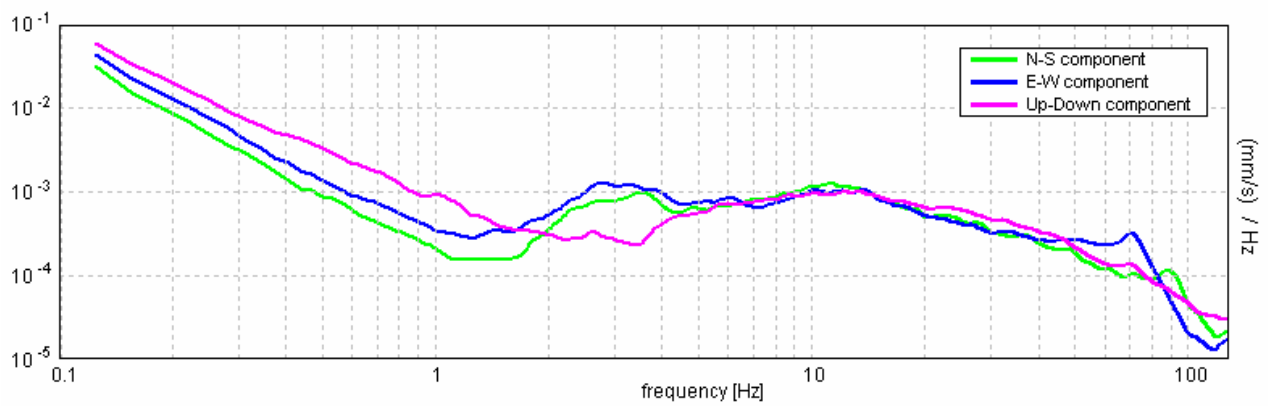
H/V TIME HISTORY



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 3.38 ± 0.01 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$3.38 > 0.50$	OK	
$n_c(f_0) > 200$	$5670.0 > 200$	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 163 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	2.125 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	3.844 Hz	OK	
$A_0 > 2$	$6.17 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00136 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.0046 < 0.16875$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.2701 < 1.58$	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

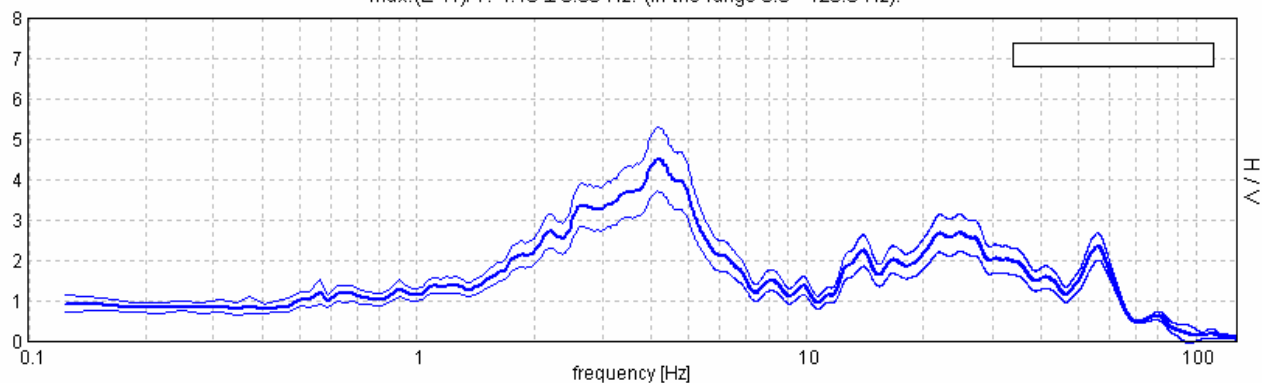
PIANOLA, 2

Start recording: 30/06/09 18:46:45 End recording: 30/06/09 19:14:46
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

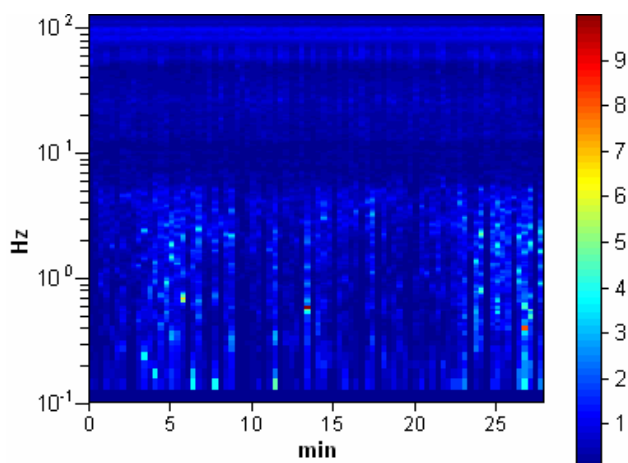
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

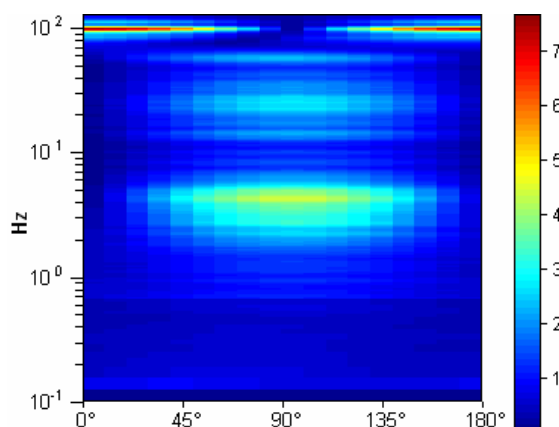
Max. (E-W)/V: 4.16 ± 0.33 Hz. (In the range 0.0 - 128.0 Hz).



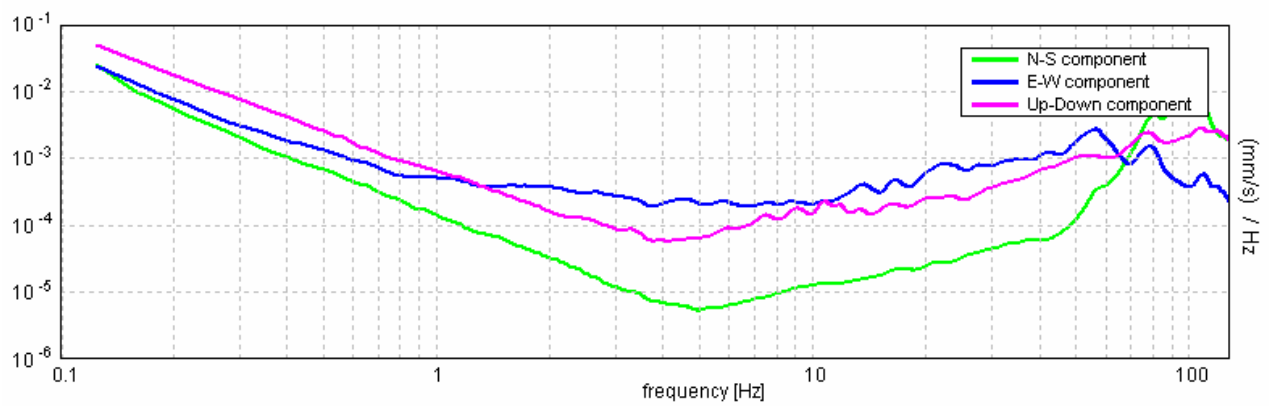
H/V TIME HISTORY



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 95.0 ± 0.05 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	95.00 > 0.50	OK	
$n_c(f_0) > 200$	159600.0 > 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 2577 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	71.031 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	101.844 Hz	OK	
$A_0 > 2$	1.25 > 2		NO
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00024 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.02252 < 4.75$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.0093 < 1.58$	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

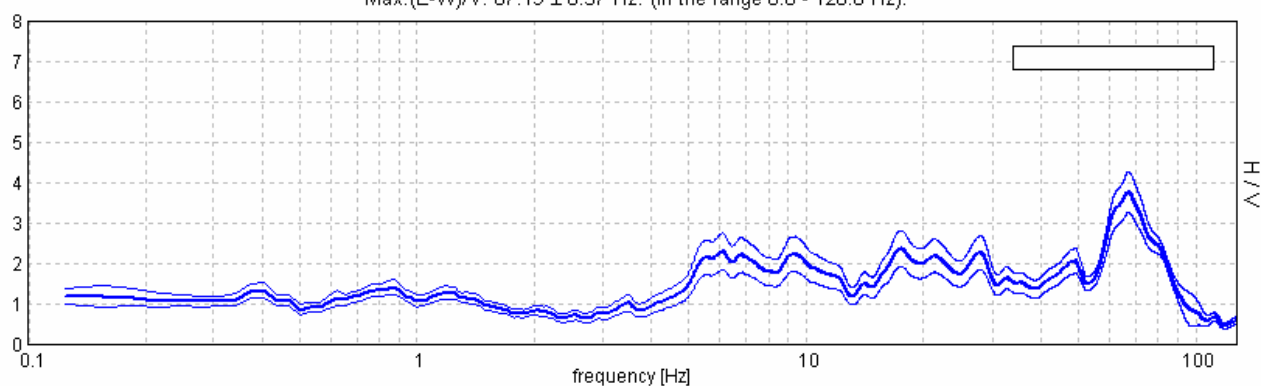
PIANOLA, 3

Start recording: 01/07/09 11:39:59 End recording: 01/07/09 12:04:18
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

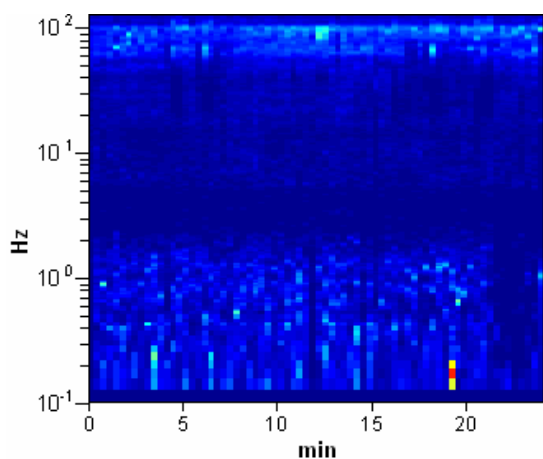
Trace length: 0h24'12". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

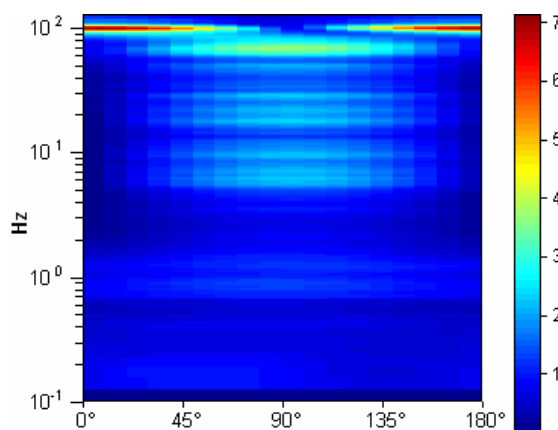
Max. (E-W)/V: 67.19 ± 0.37 Hz. (In the range 0.0 - 128.0 Hz).



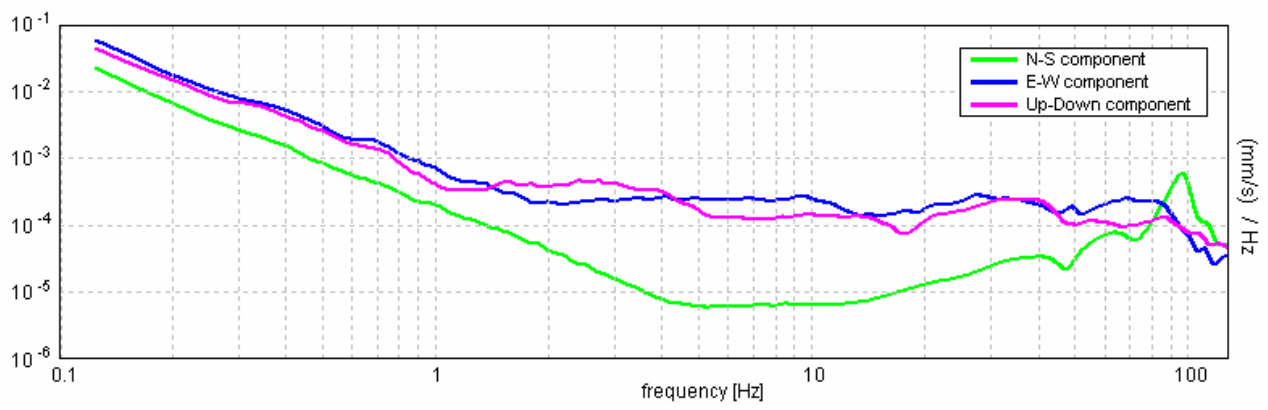
H/V TIME HISTORY



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 96.5 ± 3.12 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$96.50 > 0.50$	OK	
$n_c(f_0) > 200$	$138960.0 > 200$	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 2553 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	57.719 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	105.063 Hz	OK	
$A_0 > 2$	$2.45 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01612 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$1.55578 < 4.825$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.073 < 1.58$	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

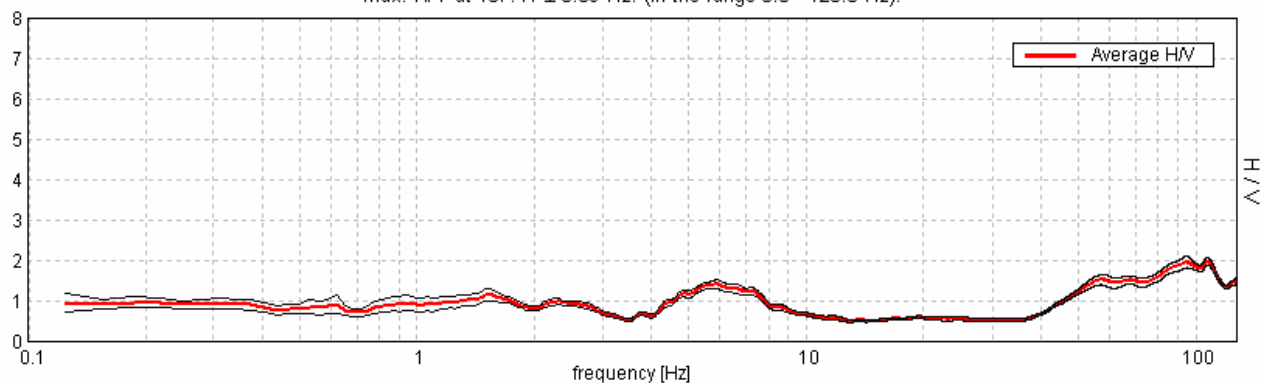
PIANOLA, 4

Start recording: 01/07/09 14:29:32 End recording: 01/07/09 14:57:33
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

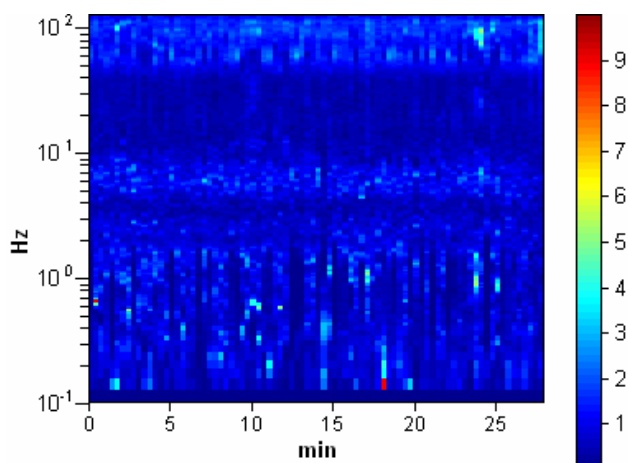
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

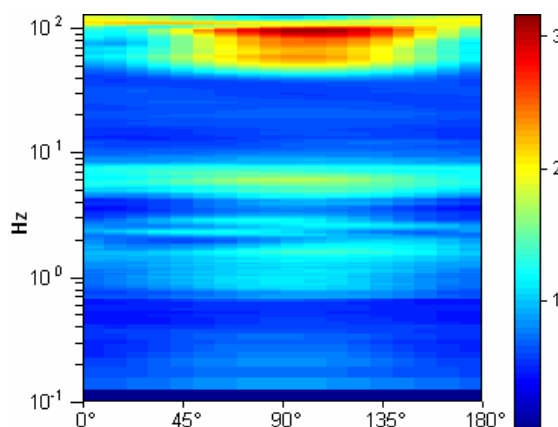
Max. H/V at 107.41 ± 5.59 Hz. (in the range 0.0 - 128.0 Hz).



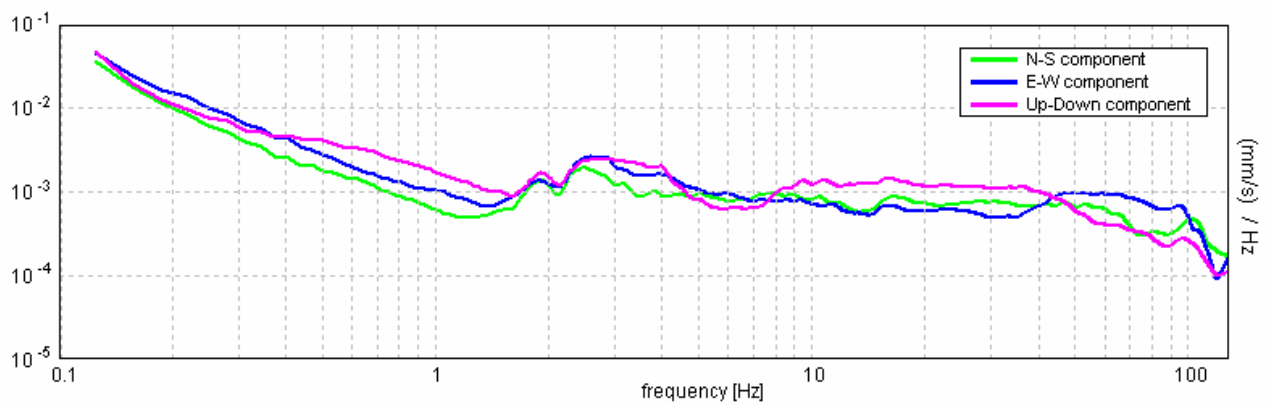
H/V TIME HISTORY



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 107.41 ± 5.59 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	107.41 > 0.50	OK	
$n_c(f_0) > 200$	180442.5 > 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 2378 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	45.438 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	2.00 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.02601 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	2.79387 < 5.37031	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.0457 < 1.58	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

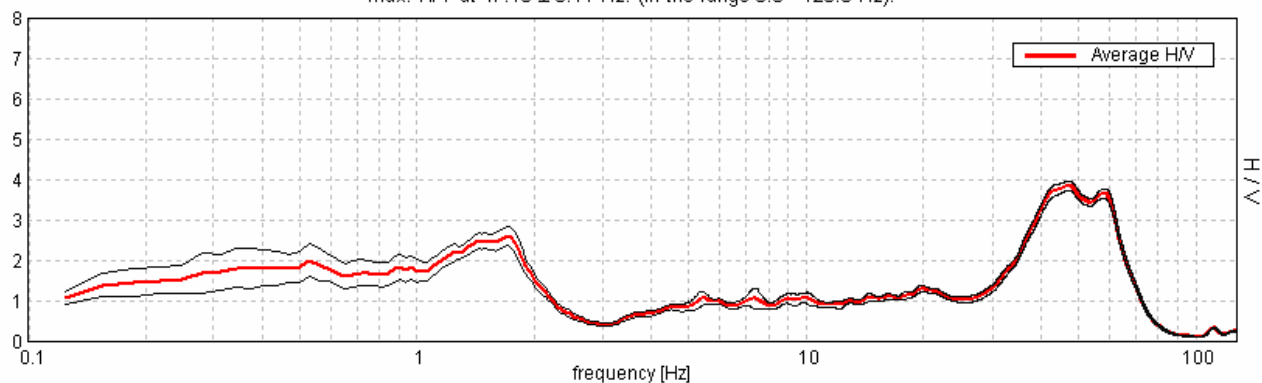
PIANOLA, 5

Start recording: 01/07/09 16:25:58 End recording: 01/07/09 16:53:59
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

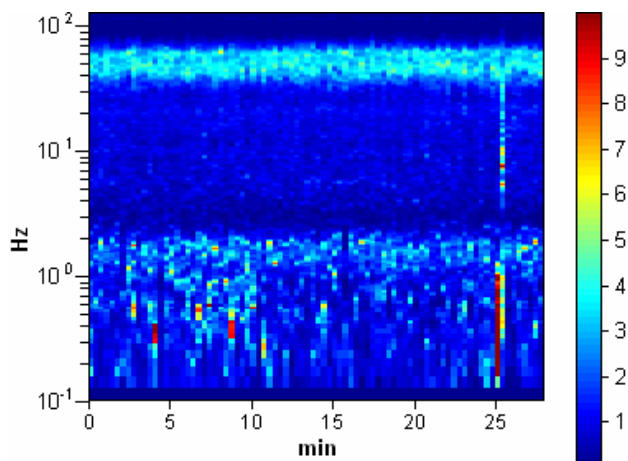
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

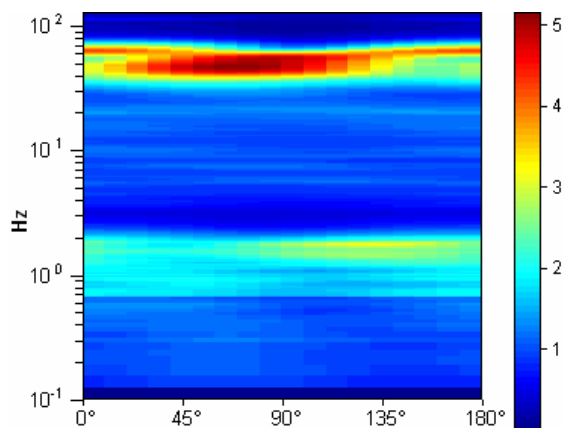
Max. H/V at 47.13 ± 0.11 Hz. (In the range 0.0 - 128.0 Hz).



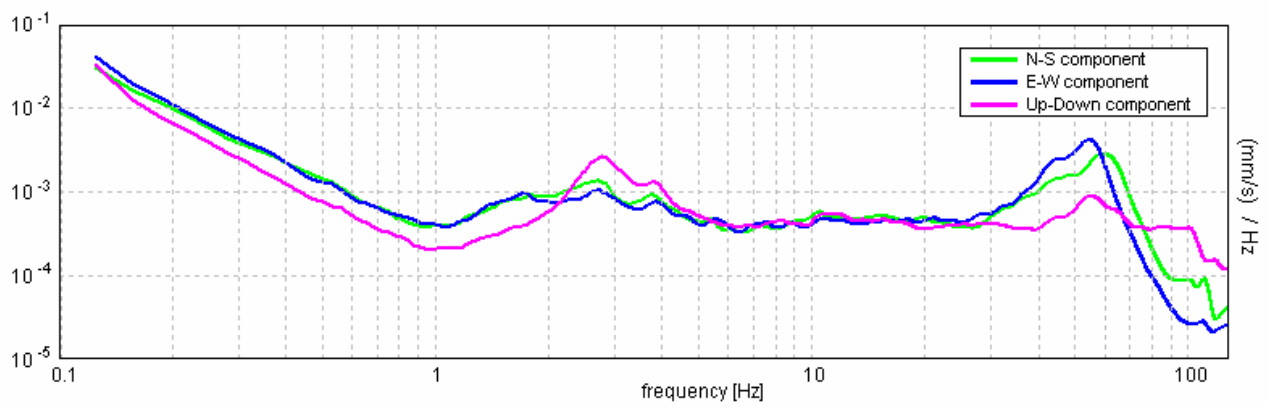
H/V TIME HISTORY



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 47.13 ± 0.11 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	47.13 > 0.50	OK	
$n_c(f_0) > 200$	79170.0 > 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 2263 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	33.969 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	66.594 Hz	OK	
$A_0 > 2$	3.85 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00112 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.05299 < 2.35625$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.0559 < 1.58$	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

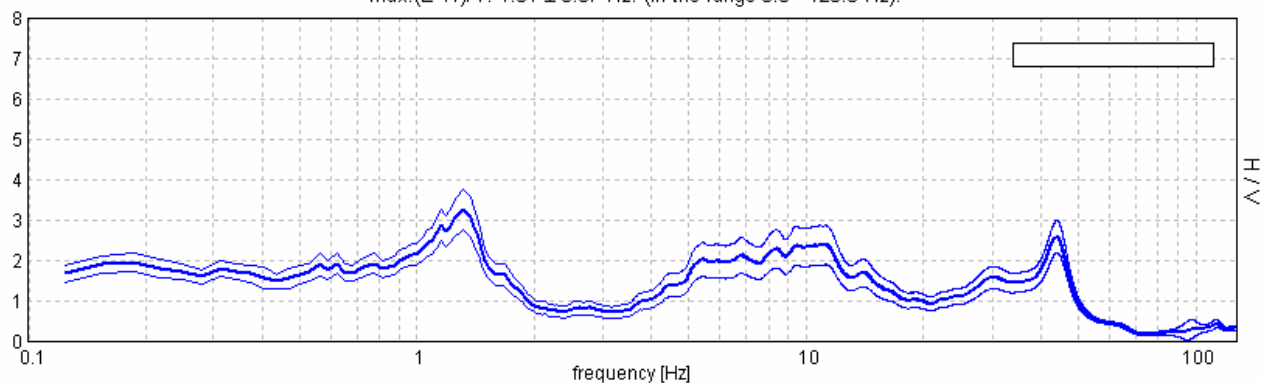
PIANOLA, 6

Start recording: 01/07/09 17:05:08 End recording: 01/07/09 17:33:09
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

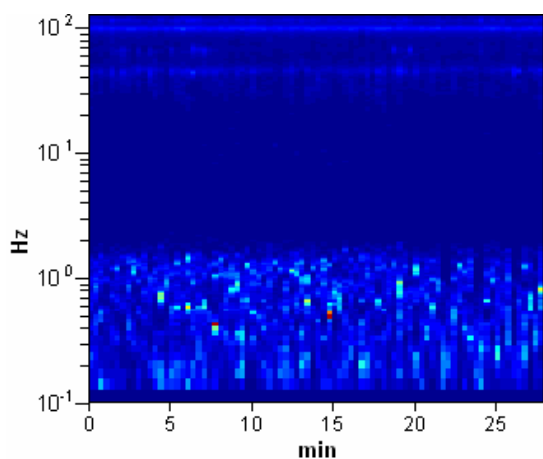
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

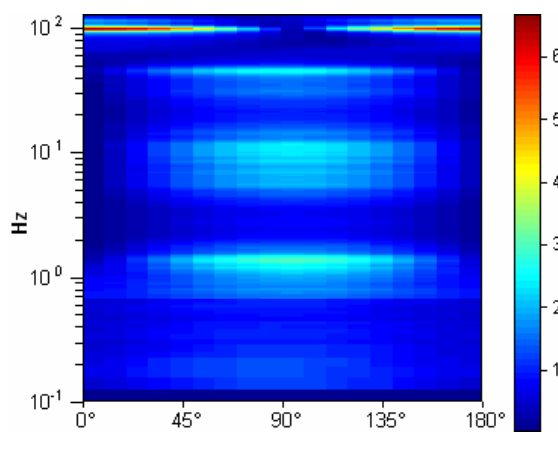
Max. (E-W)/V: 1.31 ± 0.07 Hz. (In the range 0.0 - 128.0 Hz).



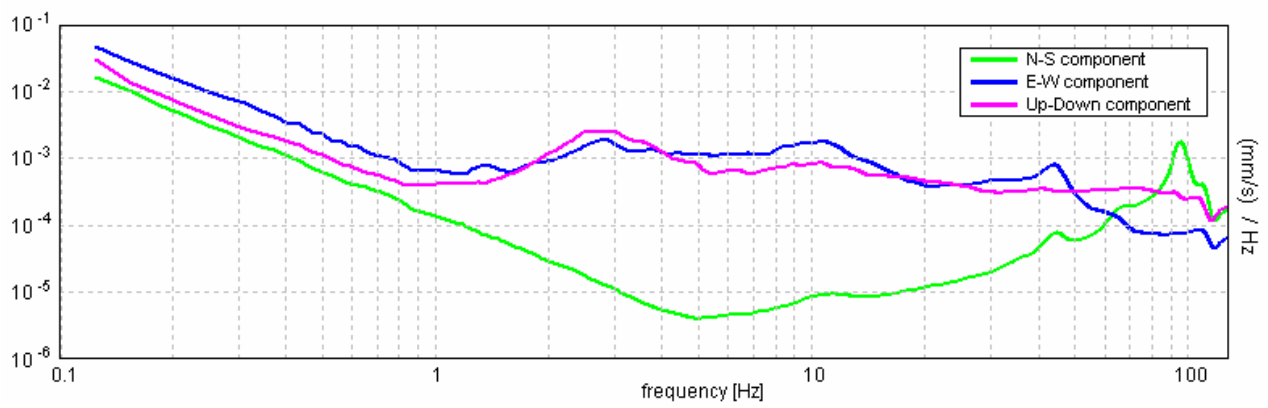
H/V TIME HISTORY



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 96.78 ± 7.61 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	96.78 > 0.50	OK	
$n_c(f_0) > 200$	162592.5 > 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 2548 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	89.281 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	115.625 Hz	OK	
$A_0 > 2$	1.43 > 2		NO
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.03932 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	3.80549 < 4.83906	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.0123 < 1.58	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

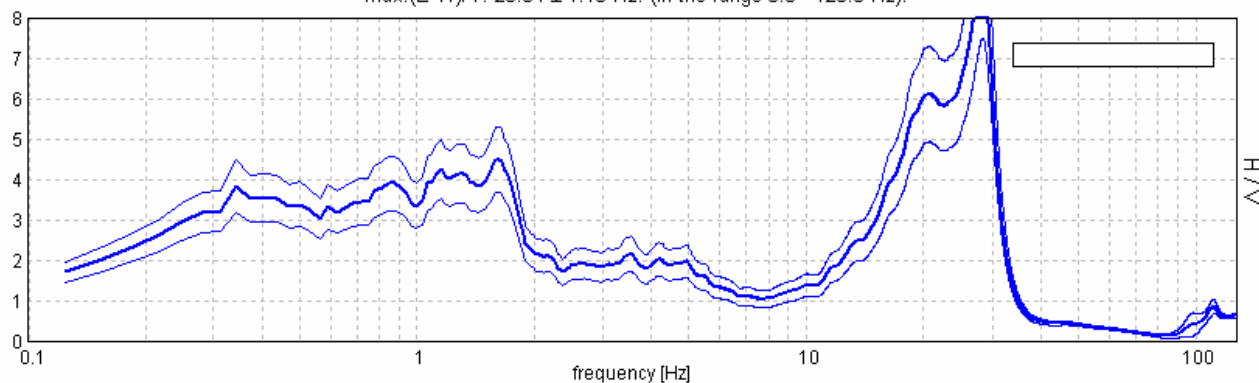
PIANOLA, 7

Start recording: 01/07/09 17:38:32 End recording: 01/07/09 18:06:32
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

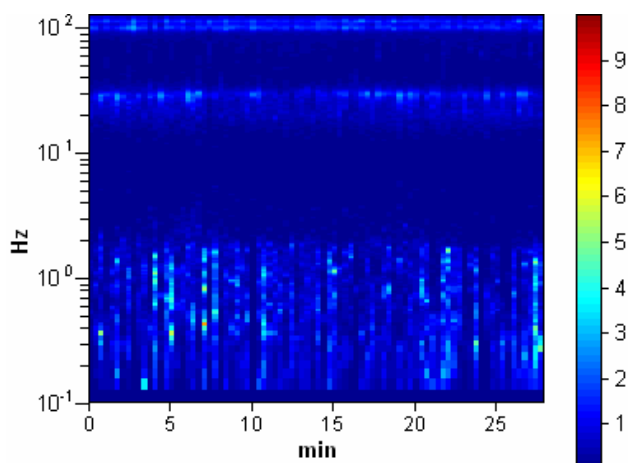
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

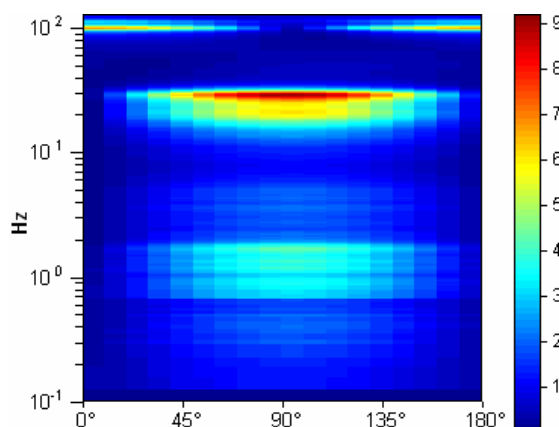
Max. (E-W)/V: 28.34 ± 1.16 Hz. (In the range 0.0 - 128.0 Hz).



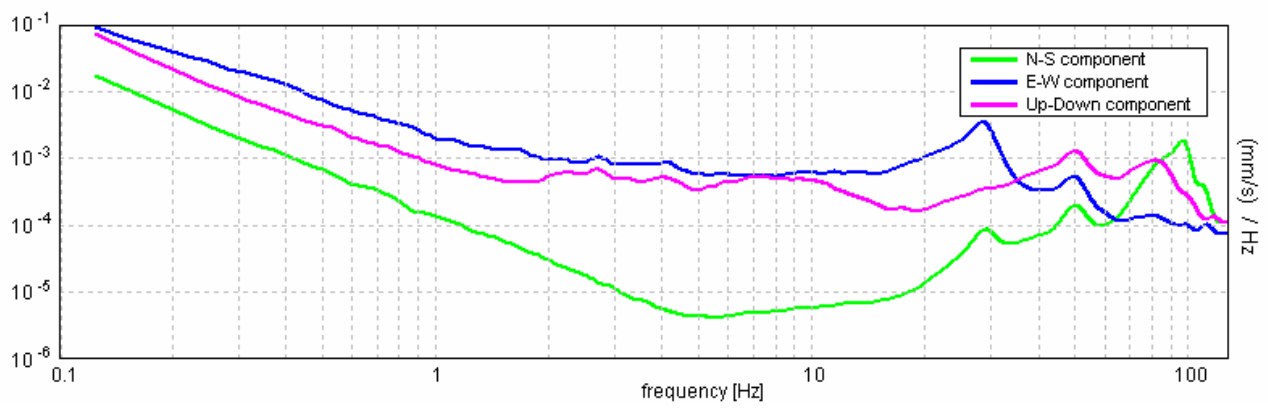
H/V TIME HISTORY



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 98.0 ± 3.34 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	98.00 > 0.50	OK	
$n_c(f_0) > 200$	164640.0 > 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 2529 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	91.844 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	117.25 Hz	OK	
$A_0 > 2$	1.71 > 2		NO
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01703 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	1.66852 < 4.9	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.0396 < 1.58	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

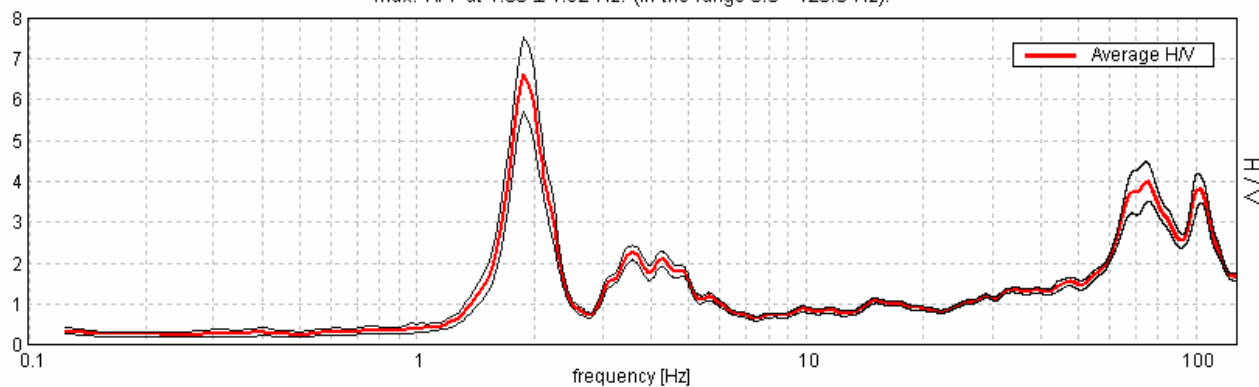
PIANOLA, MASW

Start recording: 22/07/09 15:46:12 End recording: 22/07/09 16:12:13
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

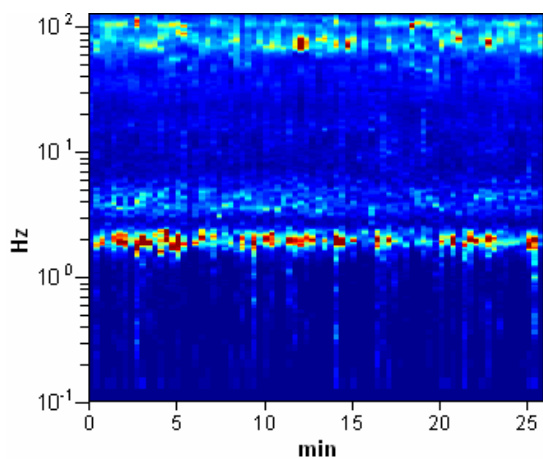
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

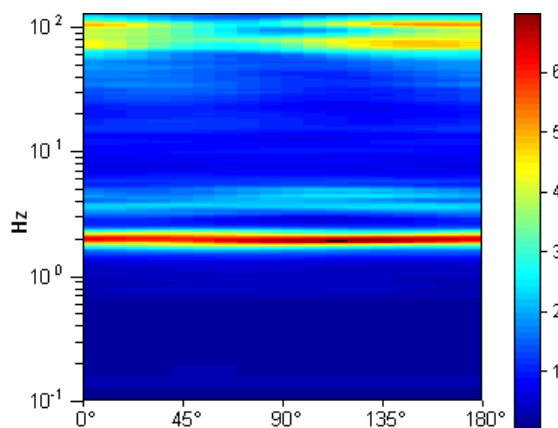
Max. H/V at 1.88 ± 1.92 Hz. (in the range 0.0 - 128.0 Hz).



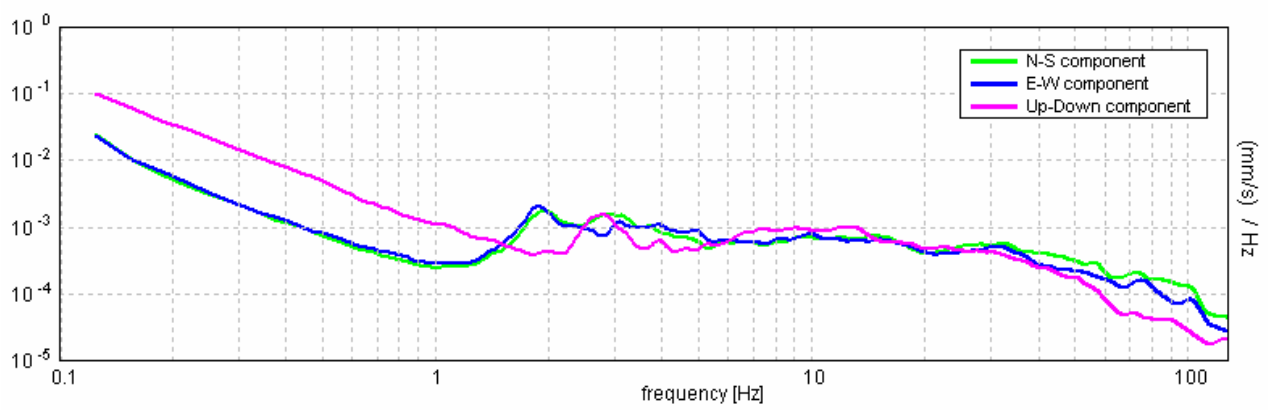
H/V TIME HISTORY



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 1.88 ± 1.92 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$1.88 > 0.50$	OK	
$n_c(f_0) > 200$	$2925.0 > 200$	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 91 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	1.656 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	2.219 Hz	OK	
$A_0 > 2$	$6.62 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.51133 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$0.95874 < 0.1875$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.4602 < 1.78$	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

	indagine ReMi		indagine H/V		
nome	Pianola 1		Pianola 1		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfaccia	H stimato (m)
1° livello	169	4.6	3.4	293	21.5
2° livello	425	14			
3° livello	306	25.6			
4° livello	610				
5° livello					
6° livello					
Vs 30	317		Classe misura		A

	indagine ReMi		indagine H/V		
nome	Pianola 2		Pianola 2		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfaccia	H stimato (m)
1° livello	158	2	strumento effettuata componente	difettoso; utilizzando orizzontale E-W	valutazione solo la
2° livello	856	27			
3° livello	497	39			
4° livello	1249				
5° livello					
6° livello					
Vs 30	632		4.1	595	36
			Classe misura		C

	indagine ReMi		indagine H/V		
nome	Pianola 3		Pianola 3		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfaccia	H stimato (m)
1° livello	173	3	strumento effettuata componente	difettoso; utilizzando orizzontale E-W	valutazione solo la
2° livello	781	28.6			
3° livello	537	55.2			
4° livello	842				
5° livello					
6° livello					
Vs 30	571		5.3	572	27
			Classe misura		C

	indagine ReMi		indagine H/V		
nome	Pianola 4		Pianola 4		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfaccia	H stimato (m)
1° livello	121	3.7	1.6	202	32
2° livello	239	9.3			
3° livello	226	28.2			
4° livello	442				
5° livello					
6° livello					
	212		Classe misura		B2

	indagine ReMi		indagine H/V		
nome	Pianola 5		Pianola 5		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfaccia	H stimato (m)
1° livello	115	1.7	1.7	404	59
2° livello	461	45.9			
3° livello	377	62.1			
4° livello	808				
5° livello					
6° livello					
Vs 30	394		Classe misura		A

	indagine ReMi		indagine H/V		
nome	Pianola 6		Pianola 6		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfaccia	H stimato (m)
1° livello	123	2.6	strumento effettuata componente	difettoso; utilizzando orizzontale E-W	valutazione solo la
2° livello	429	16.5			
3° livello	377	67.3			
4° livello	531				
5° livello					
6° livello					
Vs 30	335		1.3	357	68
			Classe misura		C

	indagine ReMi		indagine H/V		
nome	Pianola 7		Pianola 7		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfaccia	H stimato (m)
1° livello	101	1.2			
2° livello	505	53			
3° livello	307	65.2			
4° livello	947				
5° livello					
6° livello					
Vs 30	278		Classe misura		C

	indagine ReMi		indagine H/V		
nome	ianola masw (43)		Pianola masw (43)		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfaccia	H stimato (m)
1° livello	175	3	1.9	283	37
2° livello	203	4.6			
3° livello	334	9.1			
4° livello	528	17			
5° livello	256	34.4			
6° livello	300				
Vs 30	288		Classe misura		A



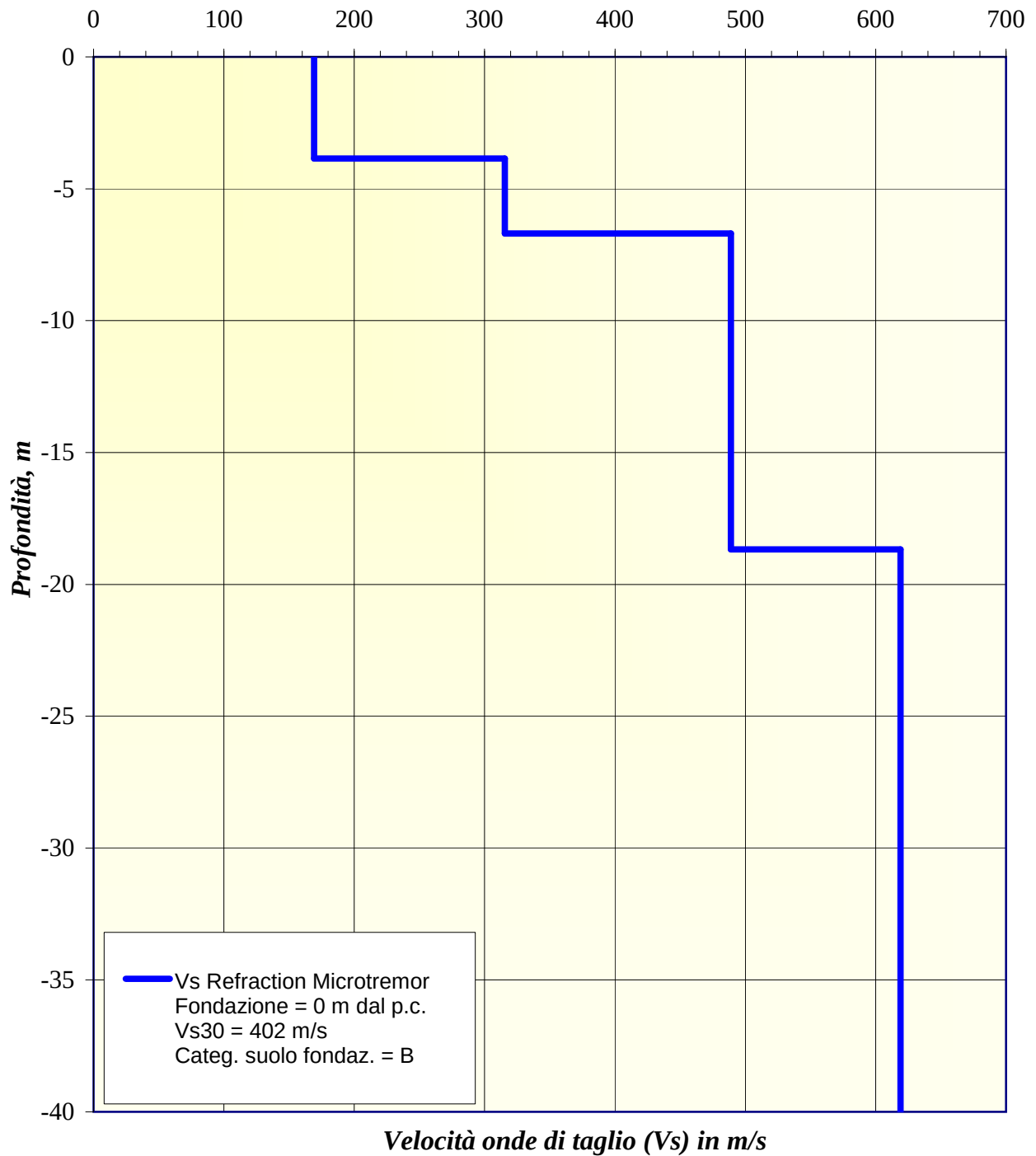
**MICROZONAZIONE SISMICA
DELLA CONCA AQUILANA
(terremoto 06-04-2009)**

Relazione tecnica finale di sintesi - Macroarea 9

**BAGNO GRANDE E BAGNO PICCOLO -
PROVE MASW E SISMICA PASSIVA
(REMI)**

Bagno Grande 33

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

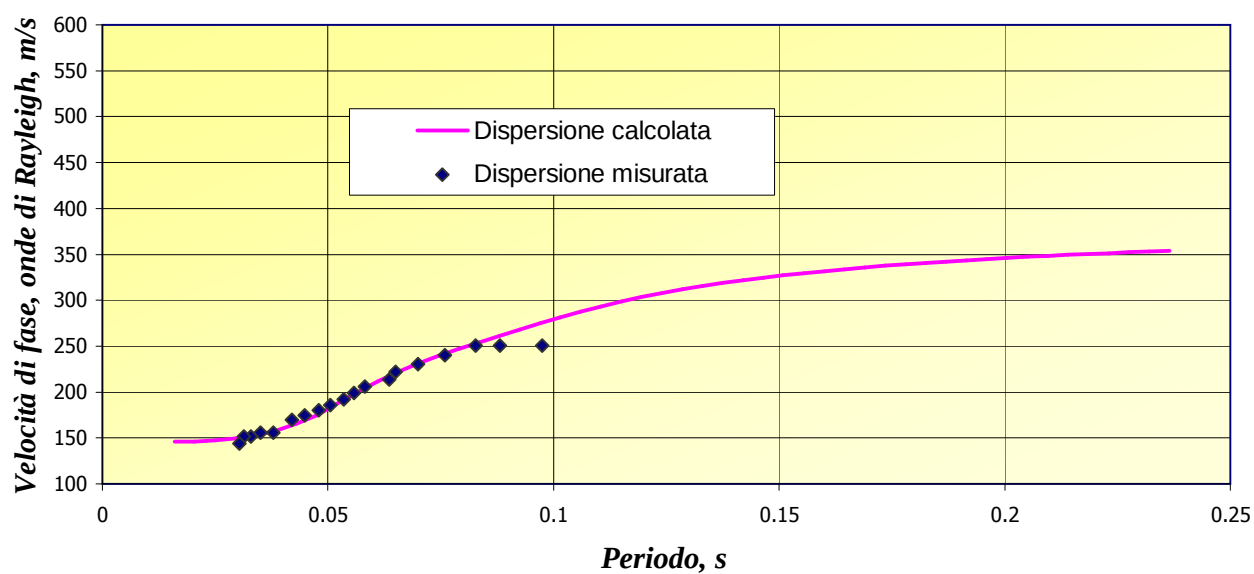
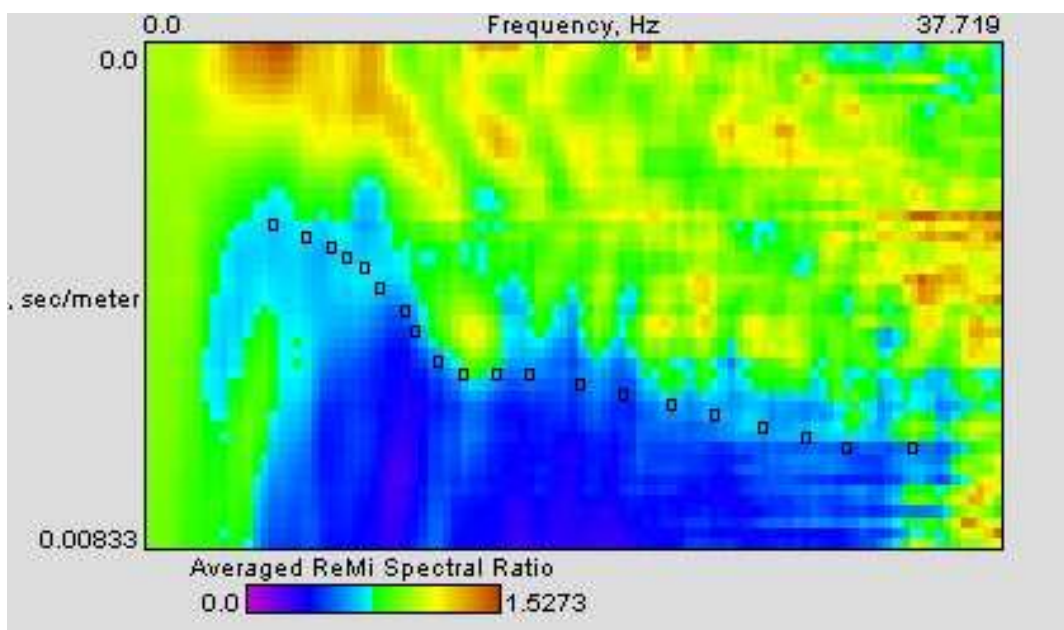
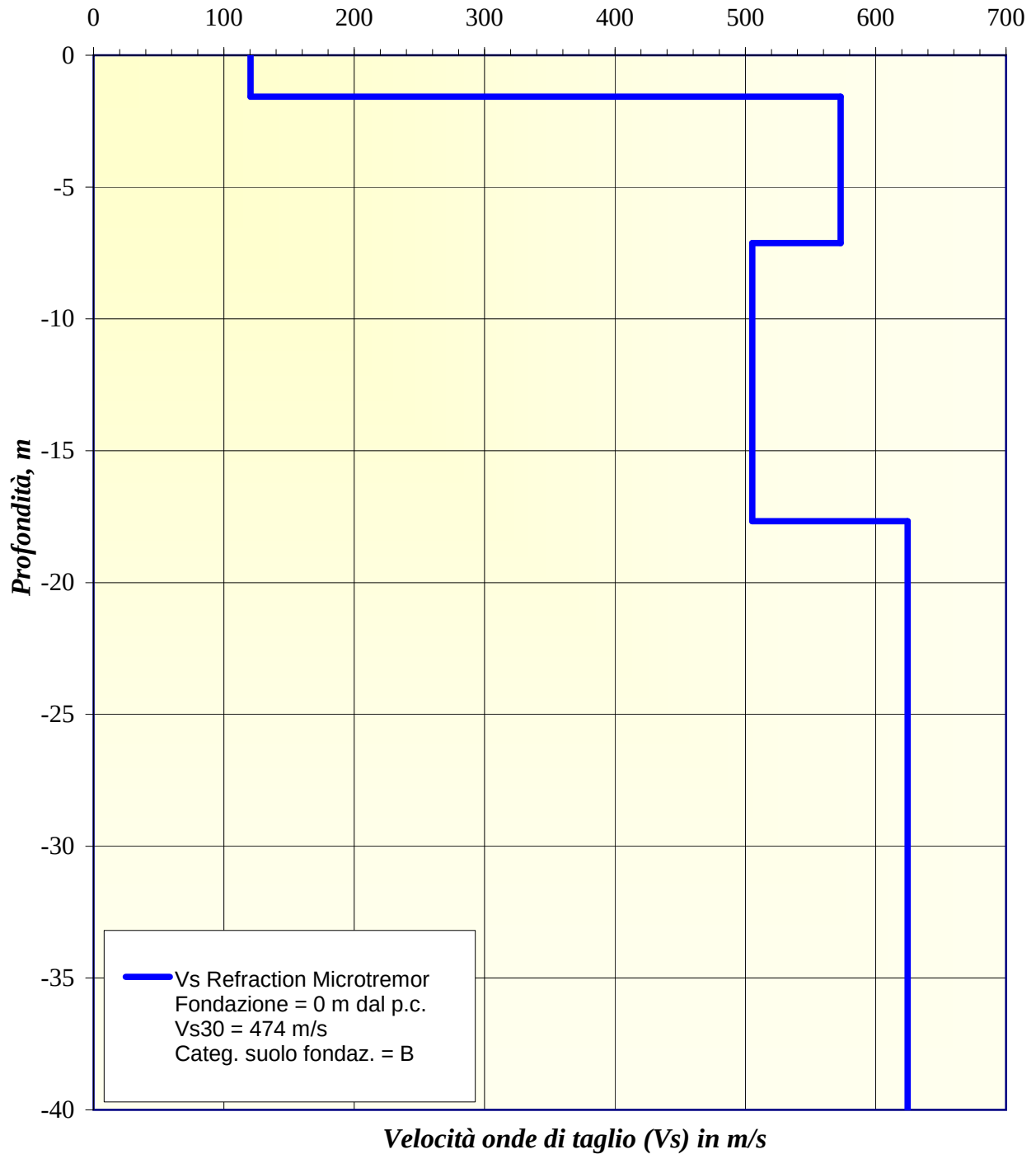


grafico slowness/frequenza



Bagno Grande 34

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

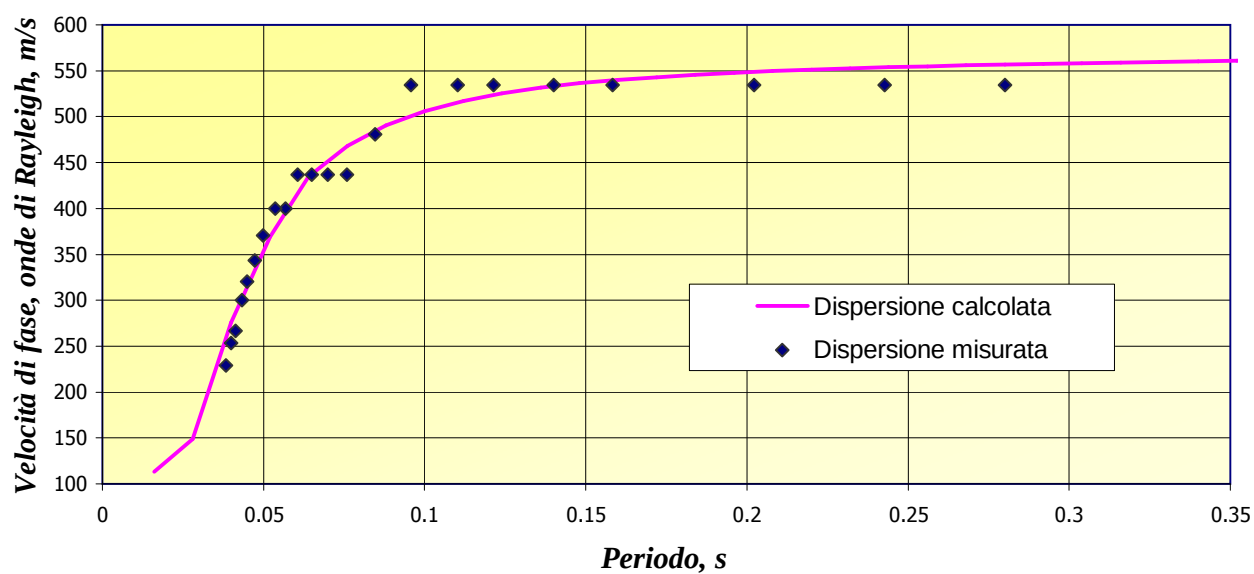
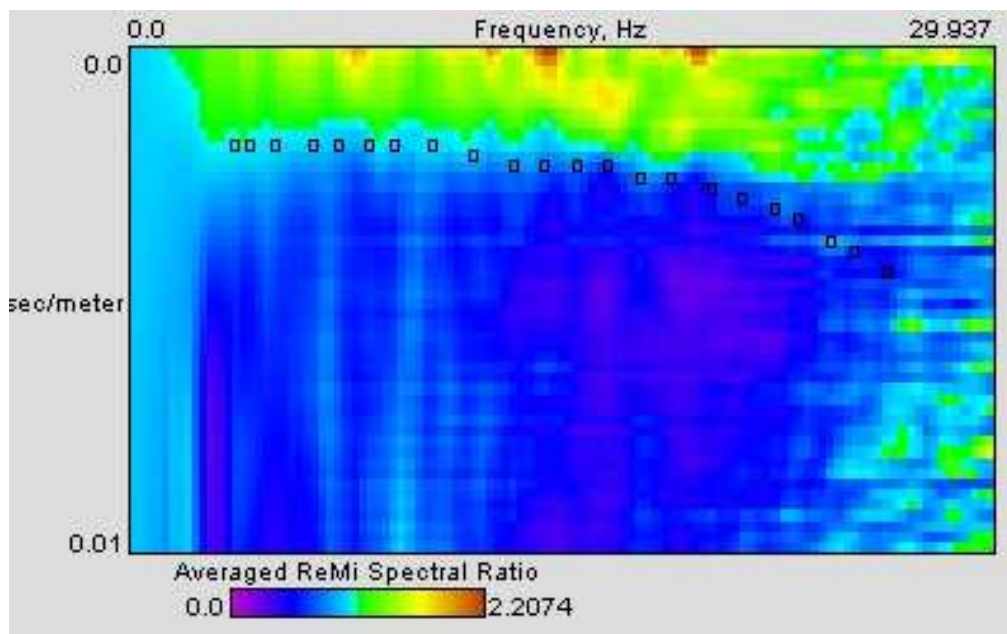
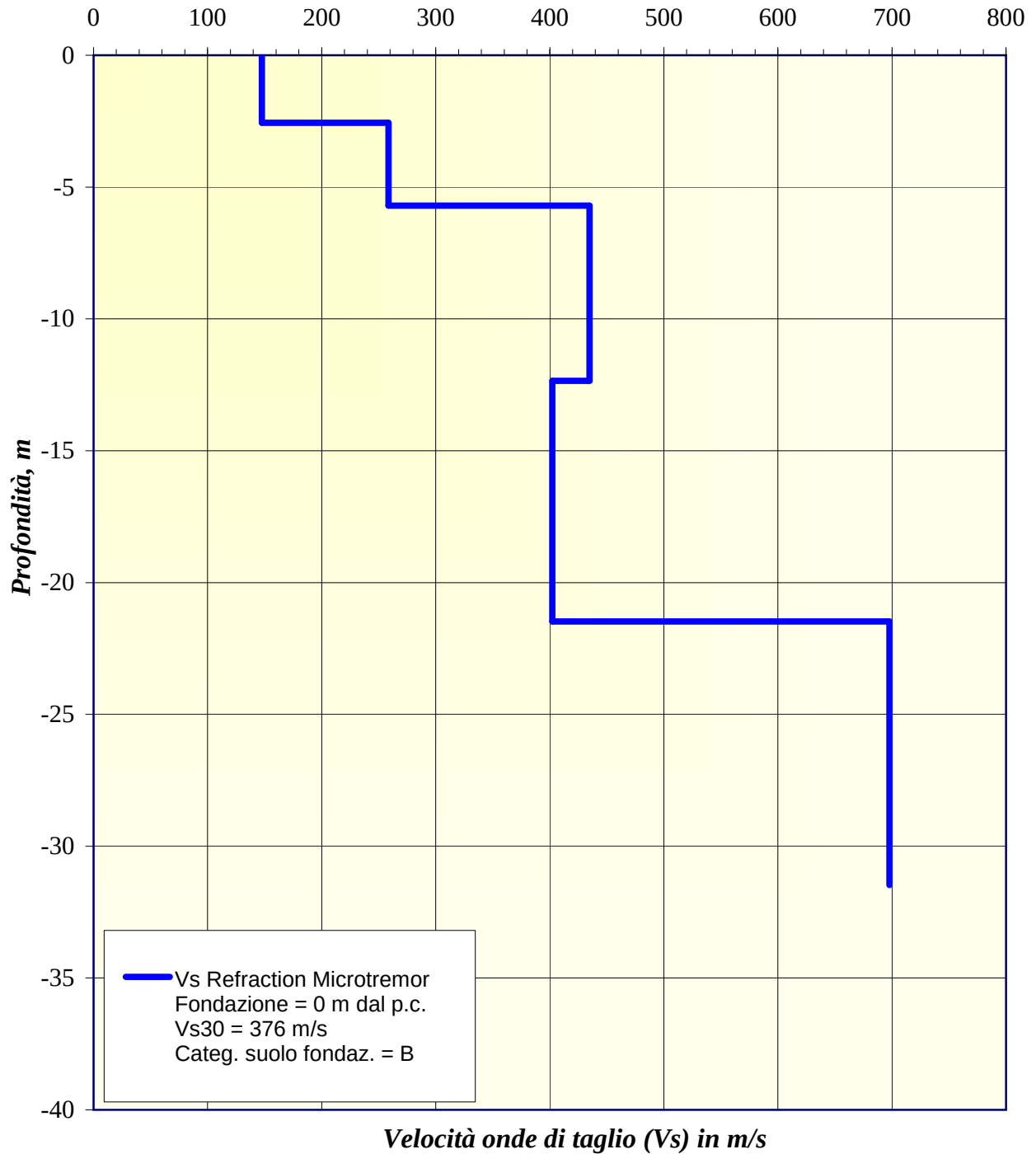


grafico slowness/frequenza



Bagno Grande 35

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

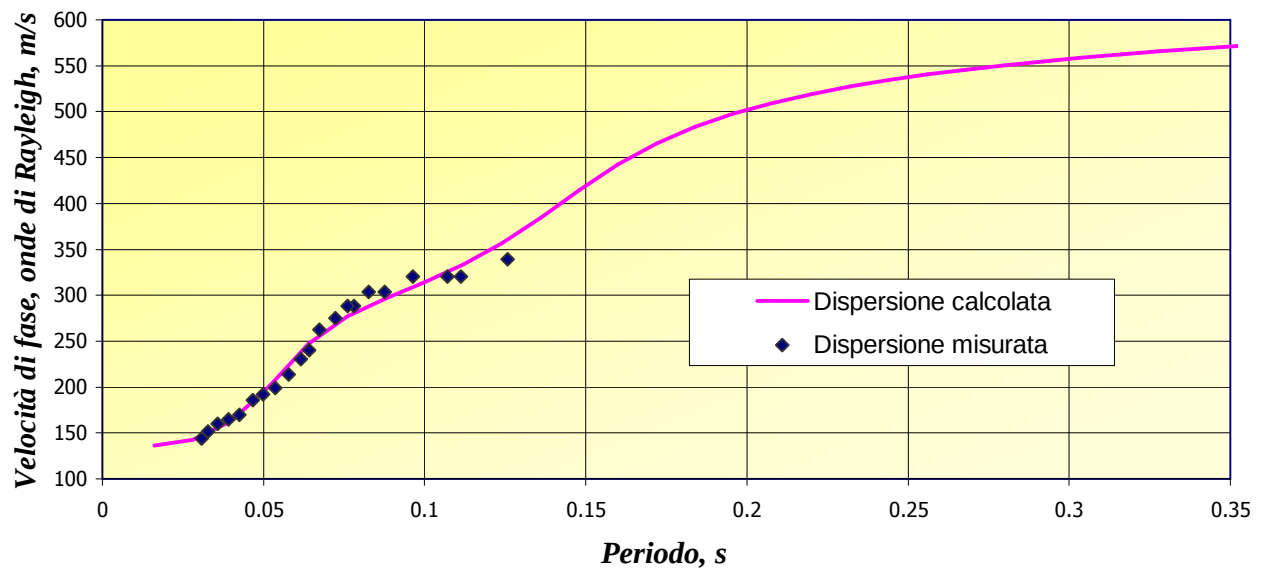
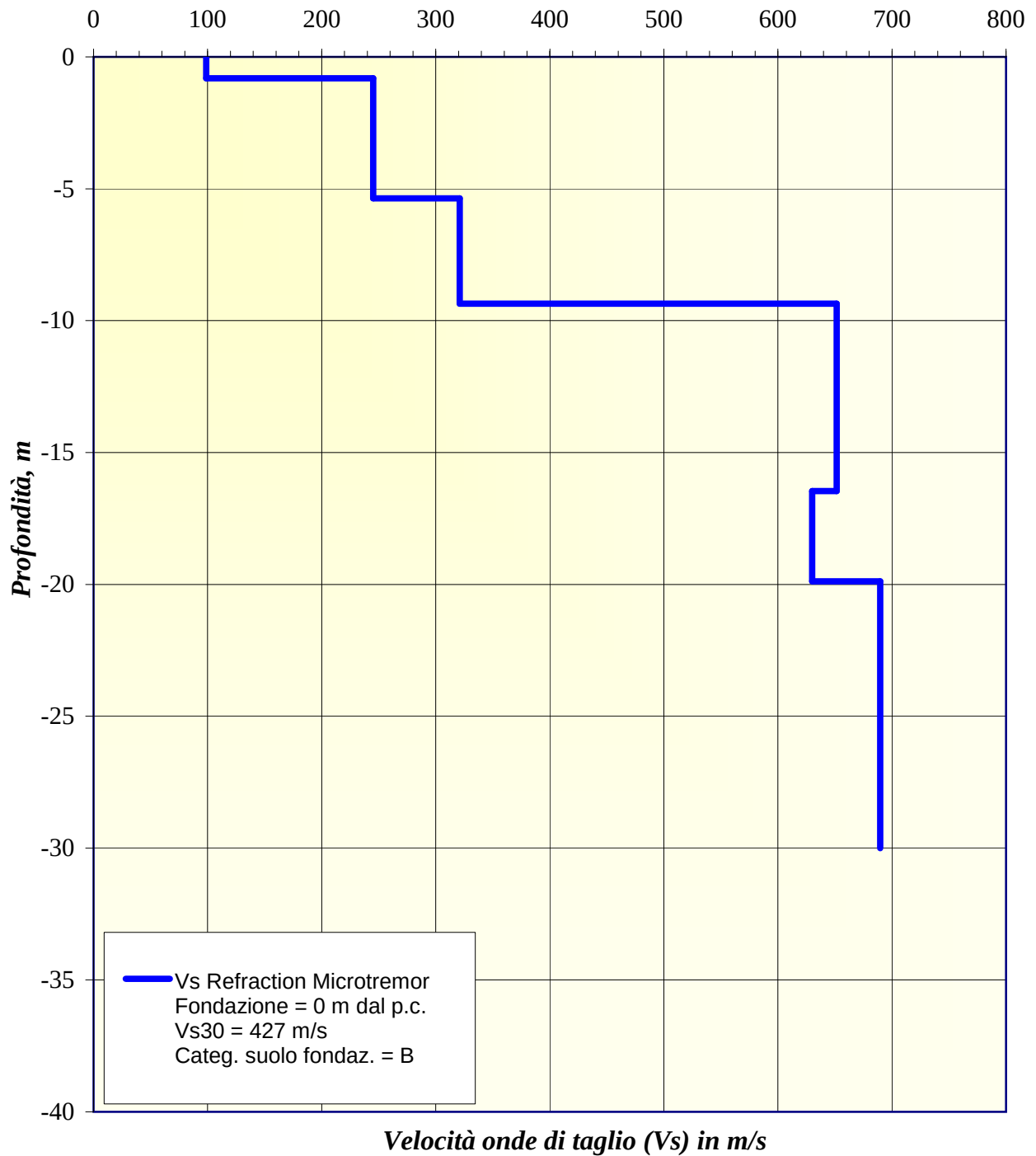


grafico slowness/frequenza

Bagno Piccolo 37

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

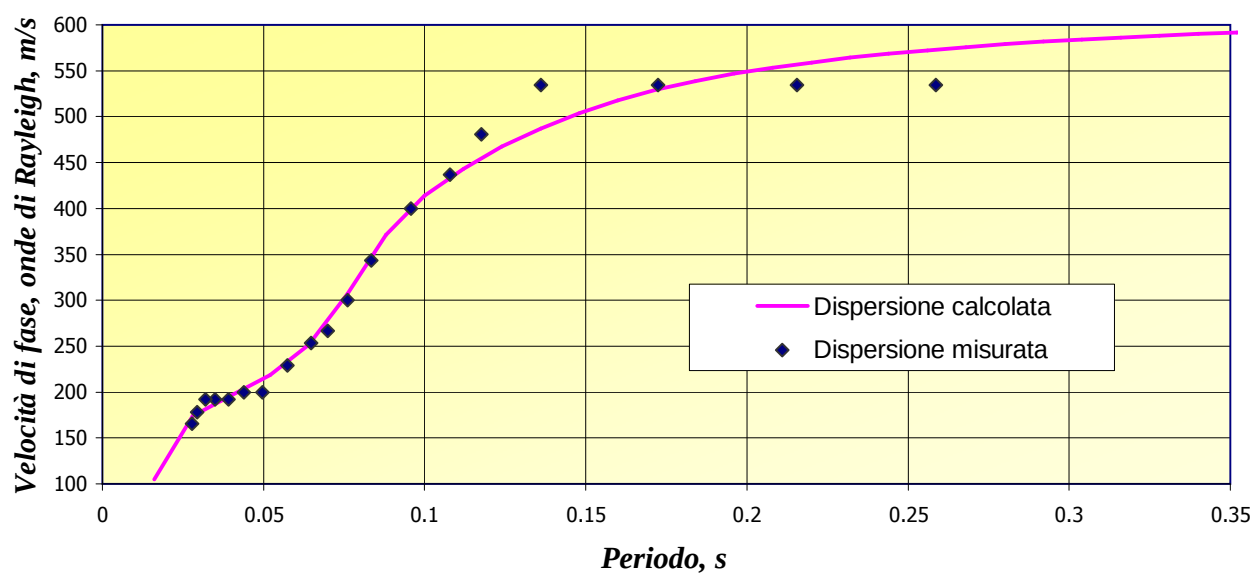
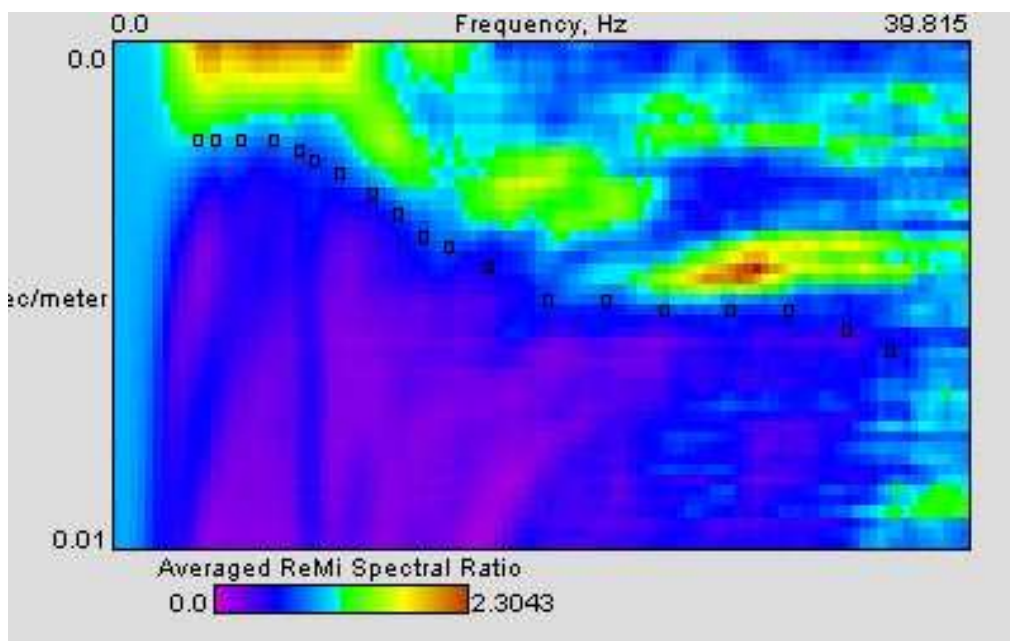


grafico slowness/frequenza



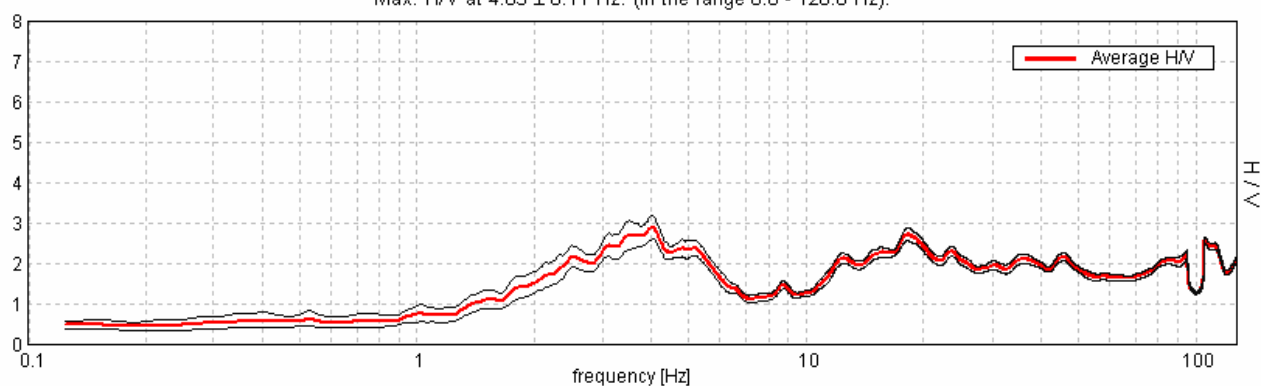
BAGNO GRANDE, 33

Start recording: 20/07/09 14:59:26 End recording: 20/07/09 15:25:27
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

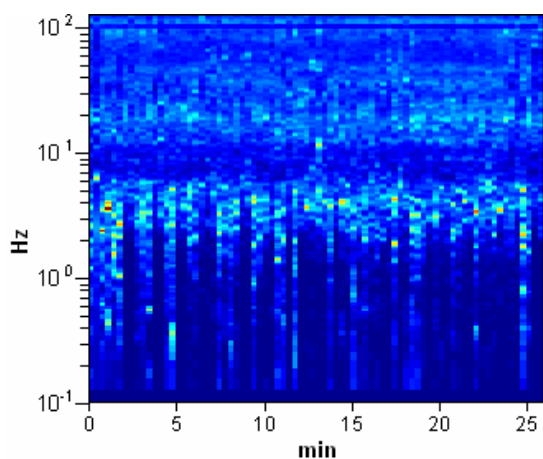
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

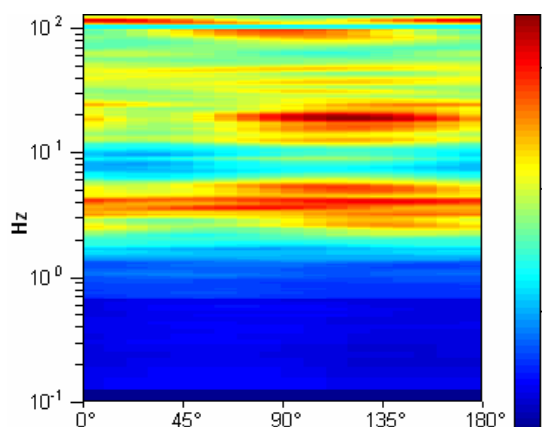
Max. H/V at 4.03 ± 0.11 Hz. (in the range 0.0 - 128.0 Hz).



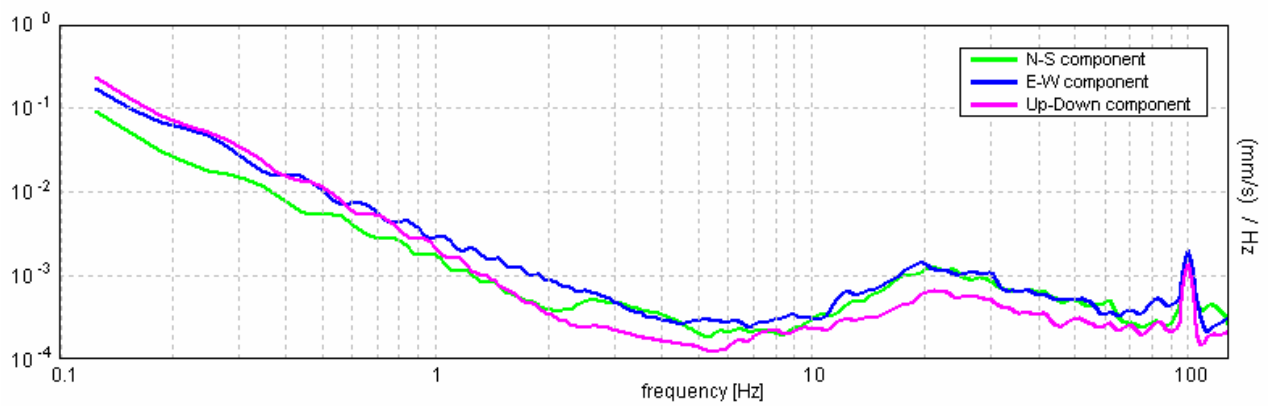
H/V TIME HISTORY



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 4.03 ± 0.11 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$4.03 > 0.50$	OK	
$n_c(f_0) > 200$	$6288.8 > 200$	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 194 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	1.906 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	6.344 Hz	OK	
$A_0 > 2$	$2.90 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01406 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.05668 < 0.20156$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1398 < 1.58$	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

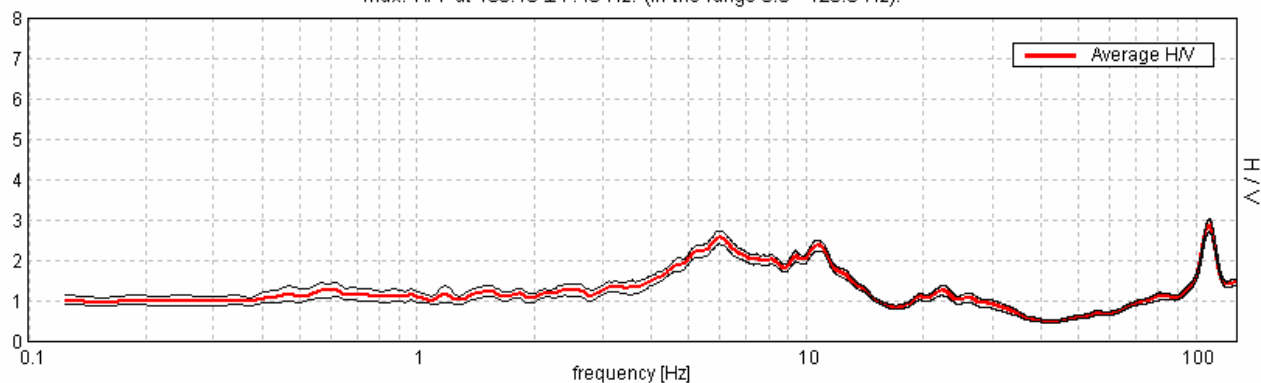
BAGNO GRANDE, 34

Start recording: 20/07/09 15:43:48 End recording: 20/07/09 16:09:49
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

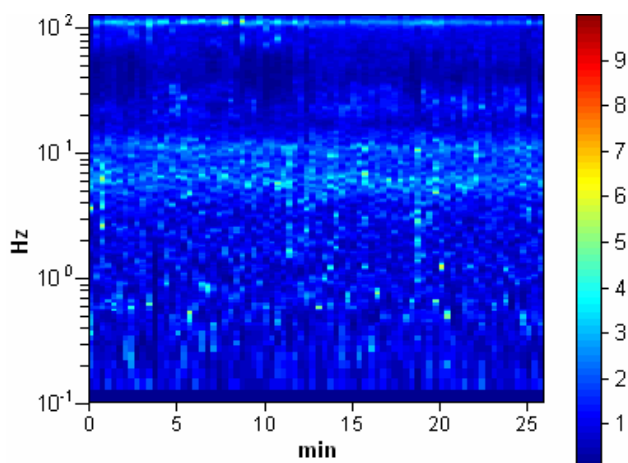
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

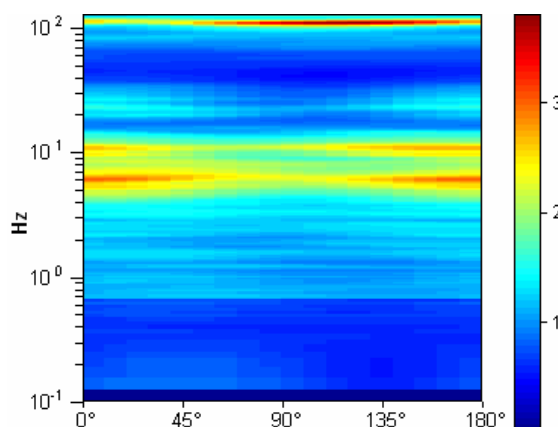
Max. H/V at 108.13 ± 7.48 Hz. (in the range 0.0 - 128.0 Hz).



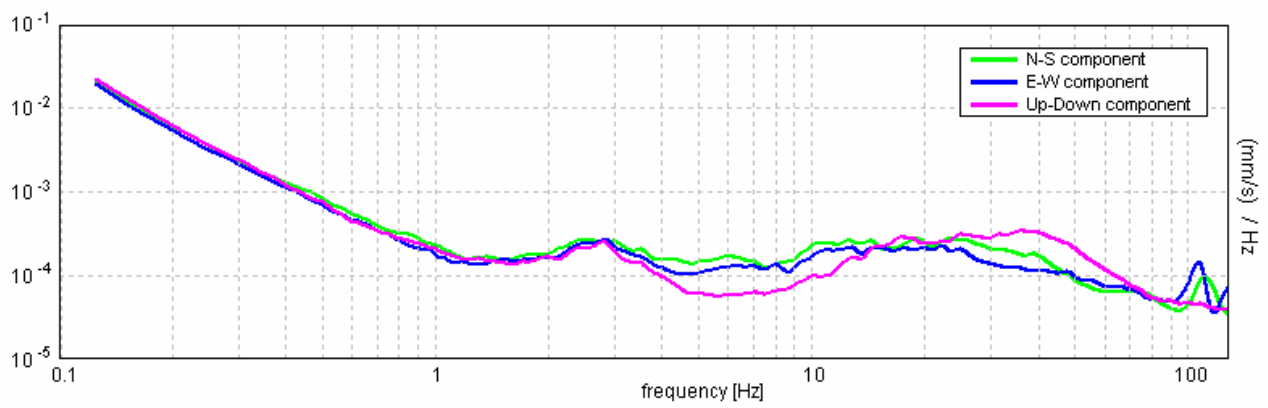
H/V TIME HISTORY



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 108.13 ± 7.48 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	108.13 > 0.50	OK	
$n_c(f_0) > 200$	168675.0 > 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 2367 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	98.0 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	118.531 Hz	OK	
$A_0 > 2$	2.88 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.03449 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$3.72931 < 5.40625$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.0792 < 1.58$	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

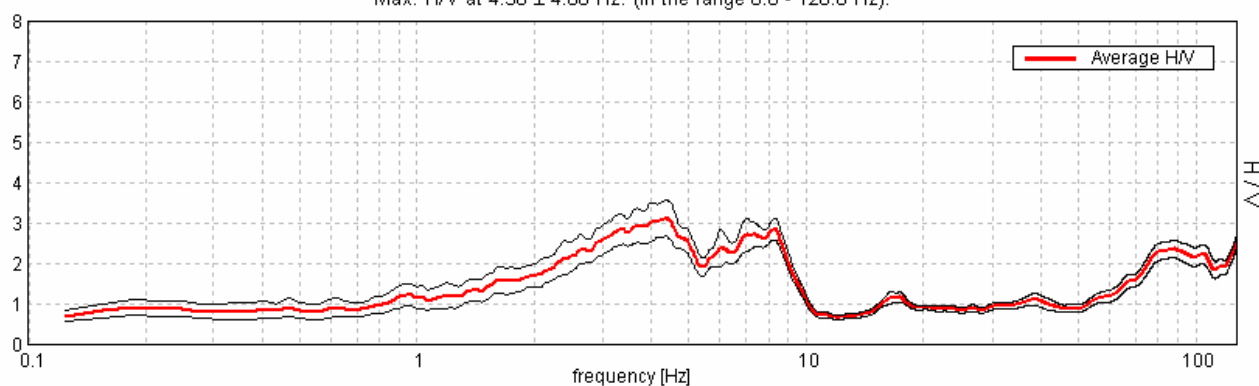
BAGNO GRANDE, 35

Start recording: 20/07/09 16:28:26 End recording: 20/07/09 16:54:27
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

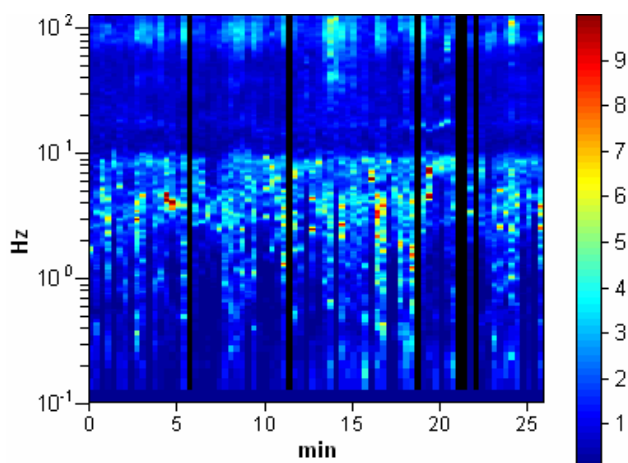
Trace length: 0h26'00". Analyzed 92% trace (manual window selection)
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

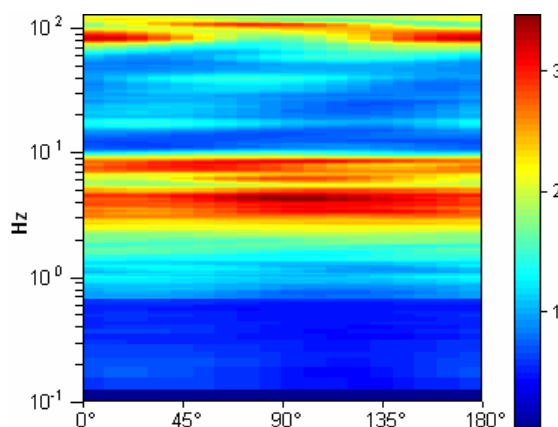
Max. H/V at 4.38 ± 4.88 Hz. (in the range 0.0 - 128.0 Hz).



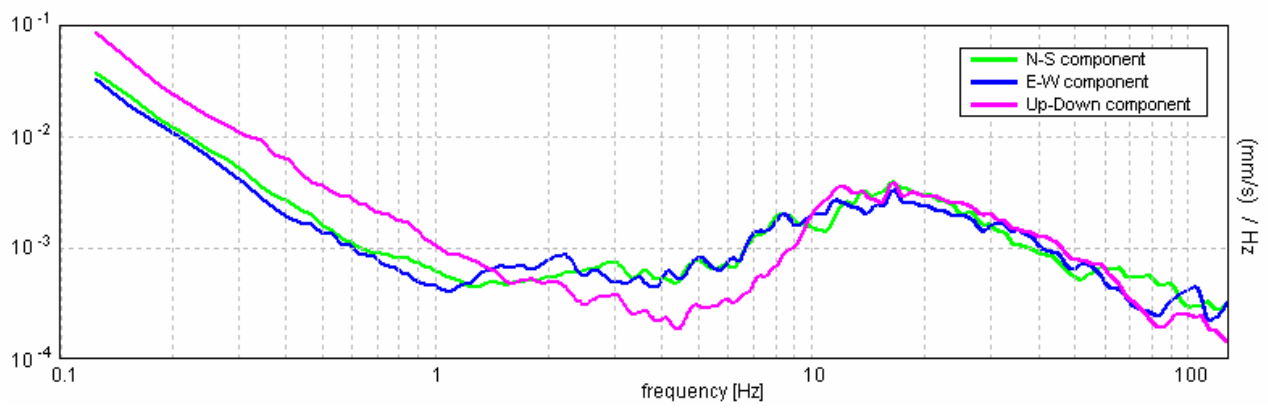
H/V TIME HISTORY



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 4.38 ± 4.88 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$4.38 > 0.50$	OK	
$n_c(f_0) > 200$	$6300.0 > 200$	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 211 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0] \mid A_{H/V}(f^-) < A_0 / 2$	1.563 Hz	OK	
Exists f^+ in $[f_0, 4f_0] \mid A_{H/V}(f^+) < A_0 / 2$	9.5 Hz	OK	
$A_0 > 2$	$3.14 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.55515 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$2.42877 < 0.21875$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.219 < 1.58$	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

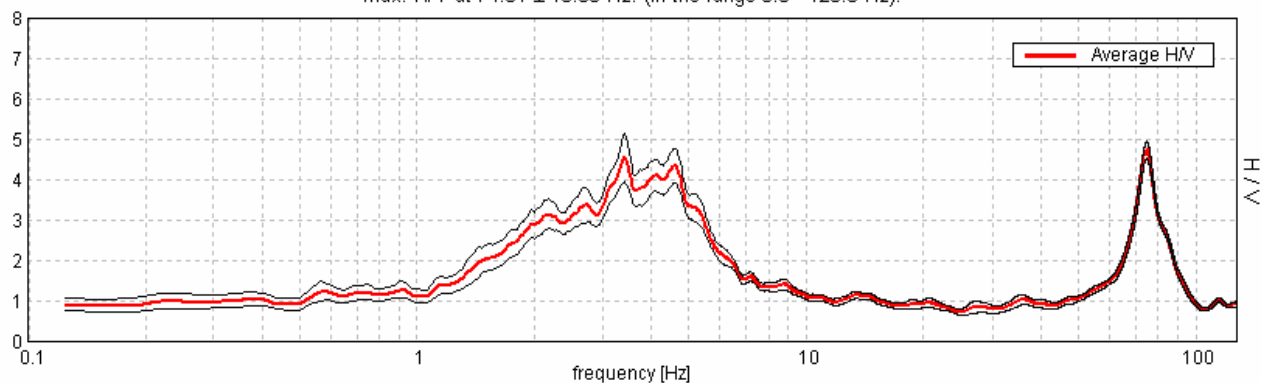
BAGNO PICCOLO, 37

Start recording: 20/07/09 17:26:39 End recording: 20/07/09 17:52:40
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

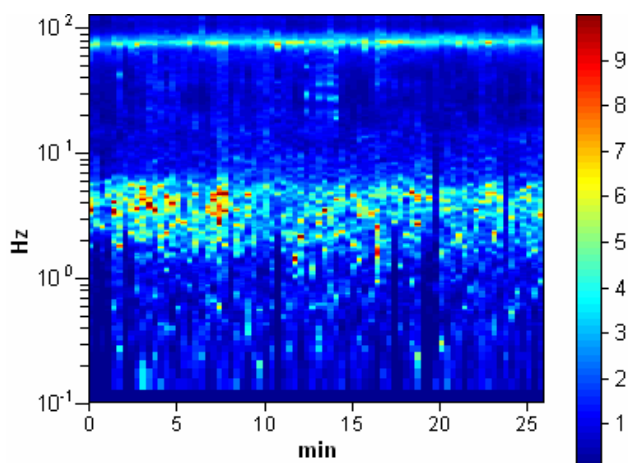
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

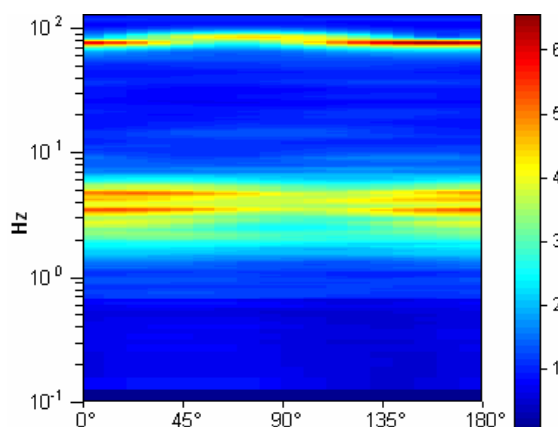
Max. H/V at 74.81 ± 13.86 Hz. (in the range 0.0 - 128.0 Hz).



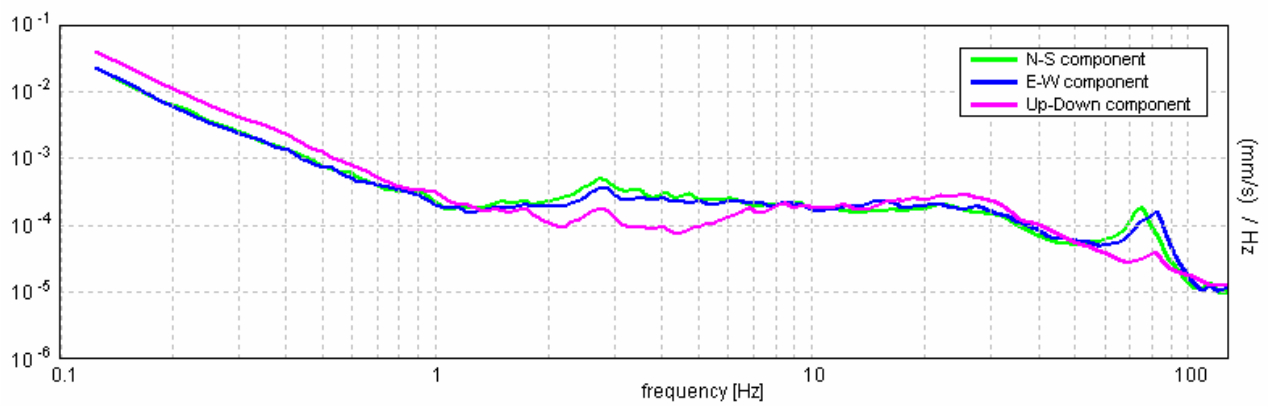
H/V TIME HISTORY



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 74.81 ± 13.86 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	74.81 > 0.50	OK	
$n_c(f_0) > 200$	116707.5 > 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 2900 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	66.875 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	86.031 Hz	OK	
$A_0 > 2$	4.74 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.09237 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$6.91061 < 3.74063$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.1064 < 1.58$	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

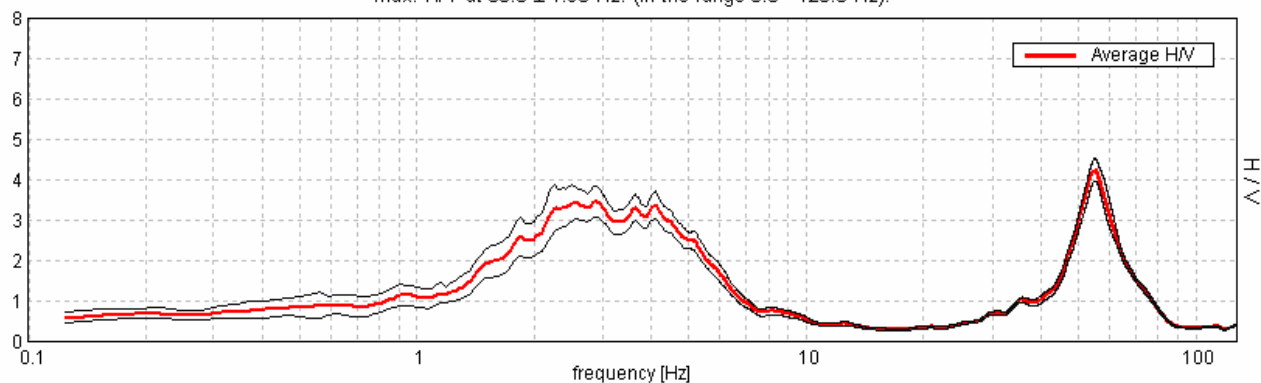
PALOMBATA, 38

Start recording: 20/07/09 18:12:53 End recording: 20/07/09 18:38:53
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

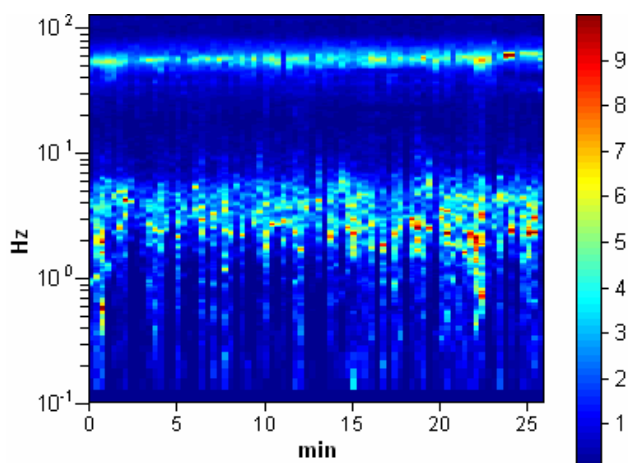
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

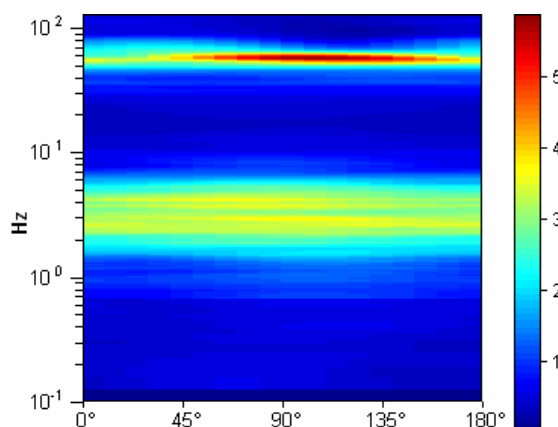
Max. H/V at 55.0 ± 1.96 Hz. (in the range 0.0 - 128.0 Hz).



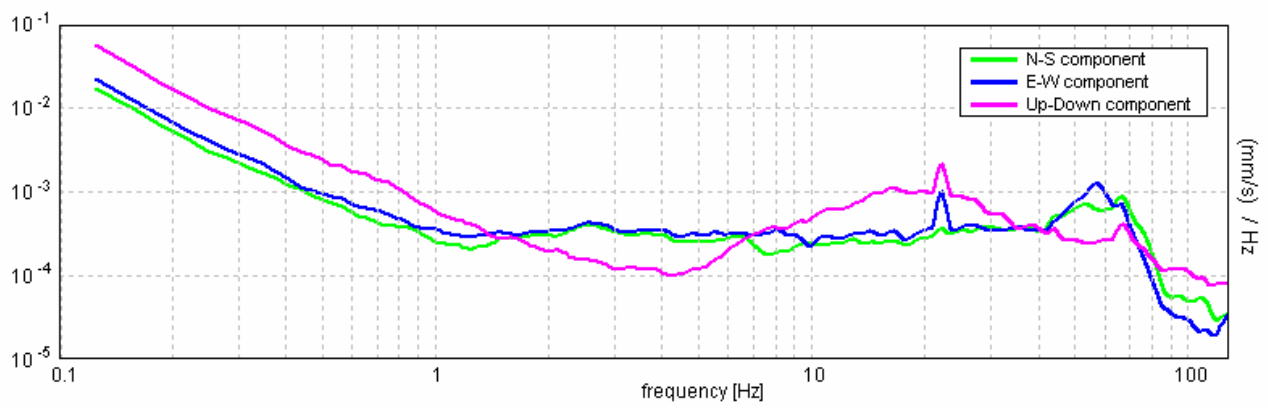
H/V TIME HISTORY



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 55.0 ± 1.96 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	55.00 > 0.50	OK	
$n_c(f_0) > 200$	85800.0 > 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 2641 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	46.906 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	64.813 Hz	OK	
$A_0 > 2$	4.25 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01781 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.97971 < 2.75$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1351 < 1.58$	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

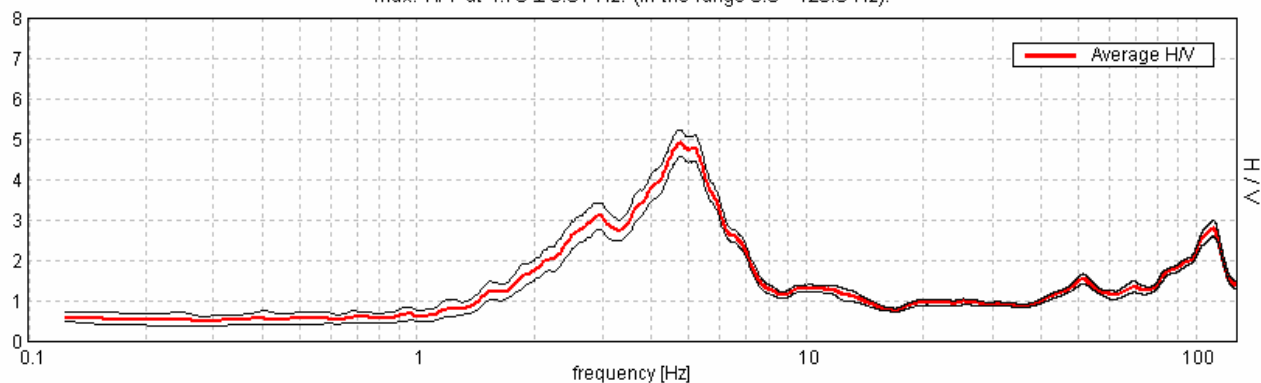
PALOMBATA, 39

Start recording: 20/07/09 18:56:30 End recording: 20/07/09 19:22:31
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

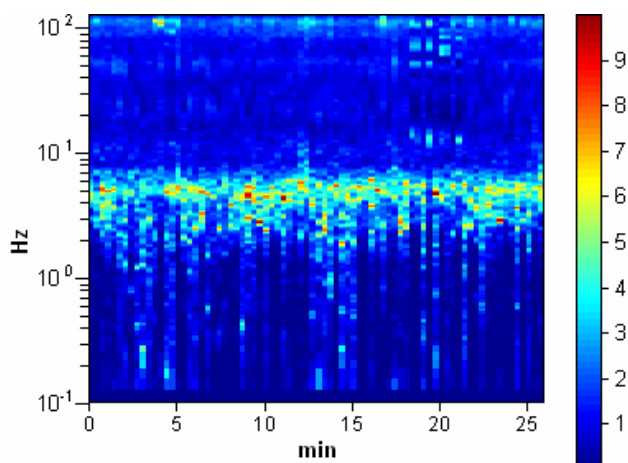
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

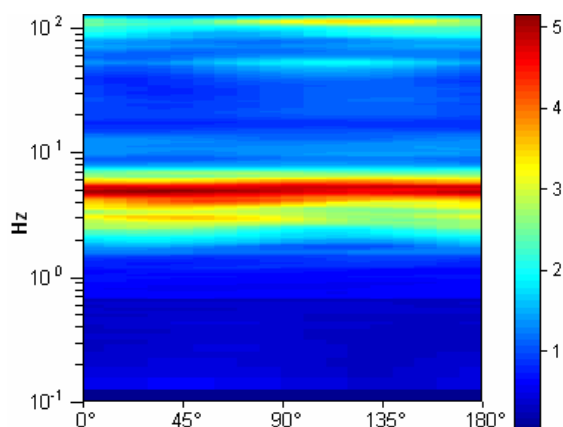
Max. H/V at 4.75 ± 0.01 Hz. (in the range 0.0 - 128.0 Hz).



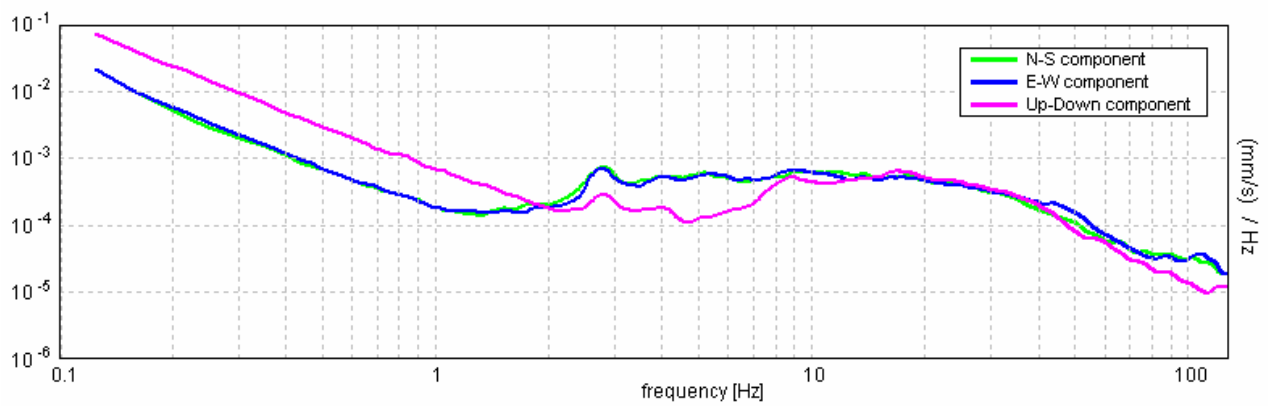
H/V TIME HISTORY



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 4.75 ± 0.01 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$4.75 > 0.50$	OK	
$n_c(f_0) > 200$	$7410.0 > 200$	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 229 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	2.406 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	6.813 Hz	OK	
$A_0 > 2$	$4.91 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00141 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.00669 < 0.2375$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1668 < 1.58$	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

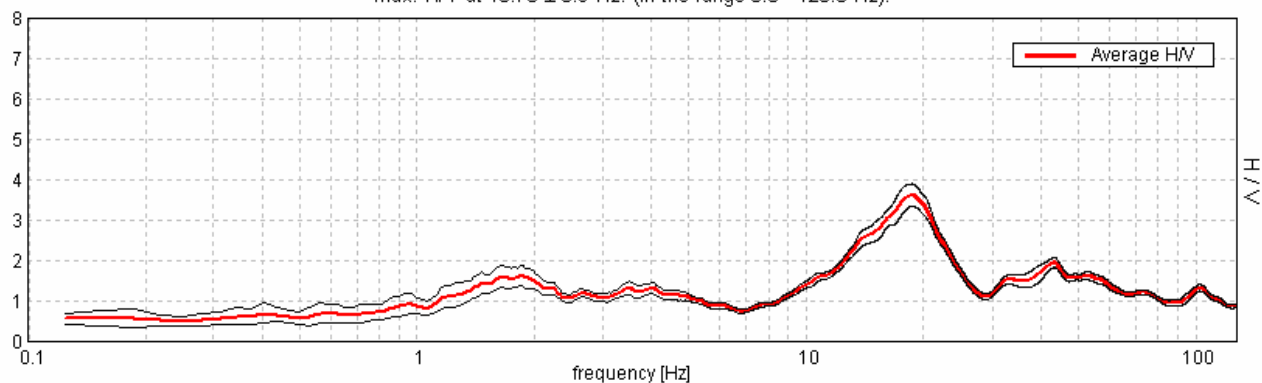
PALOMBATA, 40

Start recording: 21/07/09 08:30:19 End recording: 21/07/09 08:56:20
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

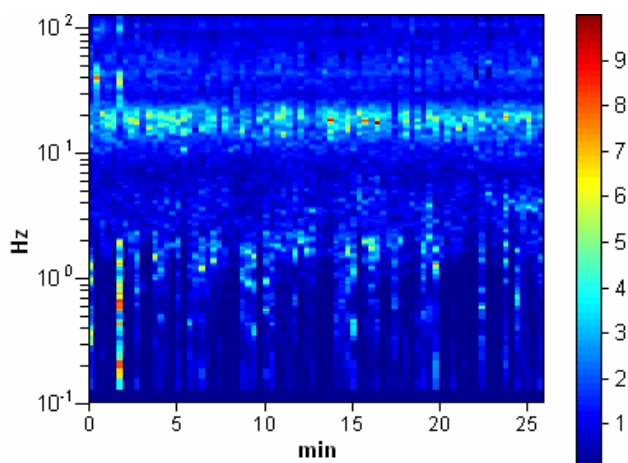
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

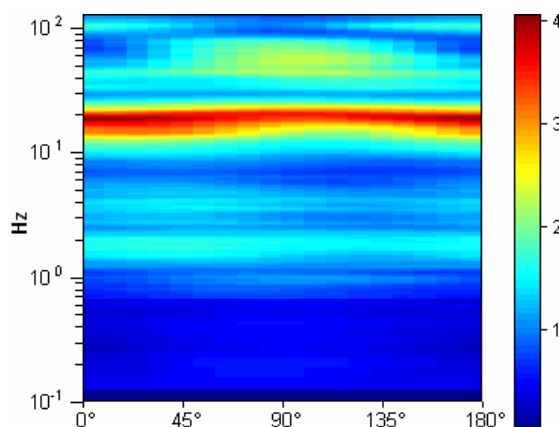
Max. H/V at 18.75 ± 0.9 Hz. (in the range 0.0 - 128.0 Hz).



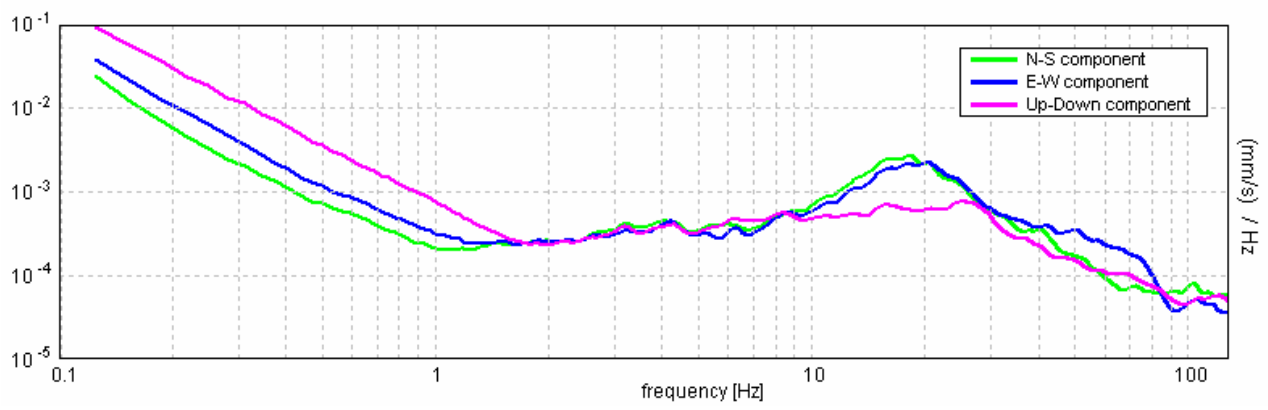
H/V TIME HISTORY



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 18.75 ± 0.9 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$18.75 > 0.50$	OK	
$n_c(f_0) > 200$	$29250.0 > 200$	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 901 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	12.0 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	24.563 Hz	OK	
$A_0 > 2$	$3.64 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.024 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.44994 < 0.9375$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1357 < 1.58$	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

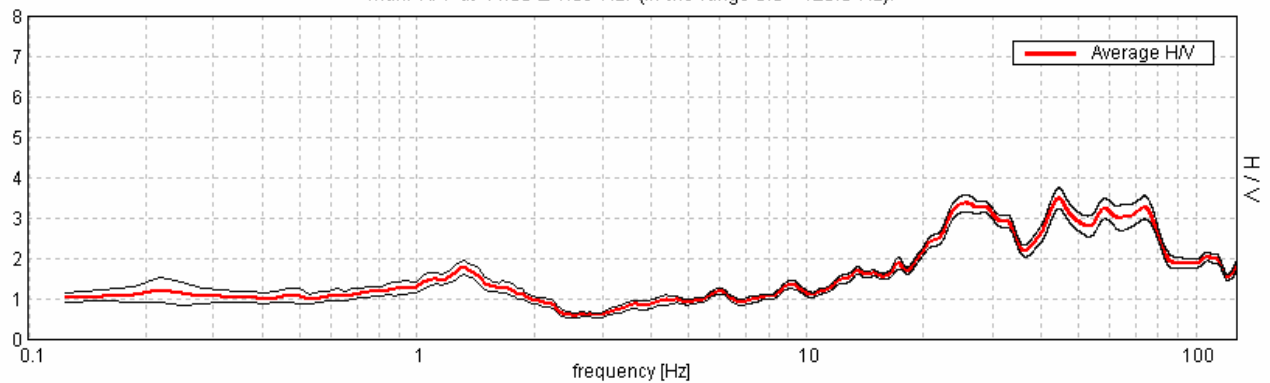
PALOMBATA, 41

Start recording: 21/07/09 09:24:38 End recording: 21/07/09 09:50:39
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

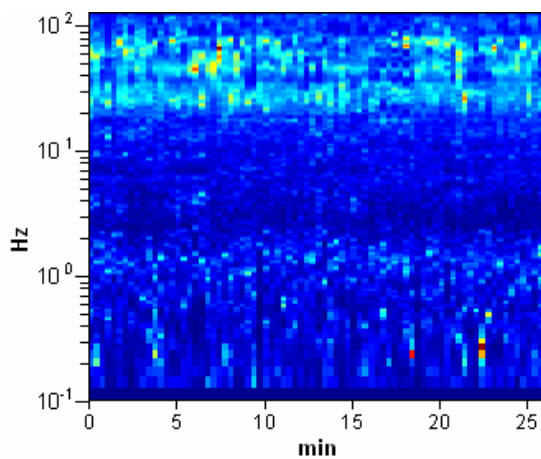
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

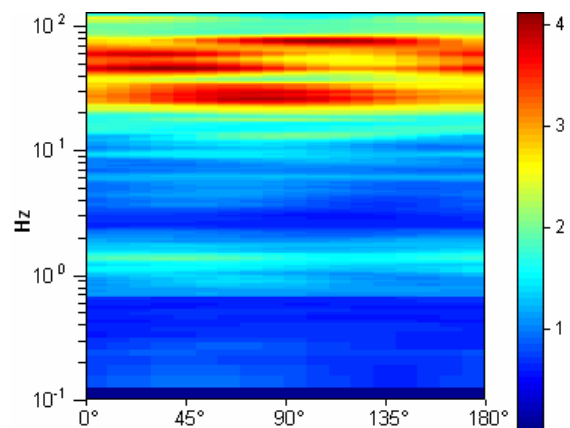
Max. H/V at 44.38 ± 1.69 Hz. (in the range 0.0 - 128.0 Hz).



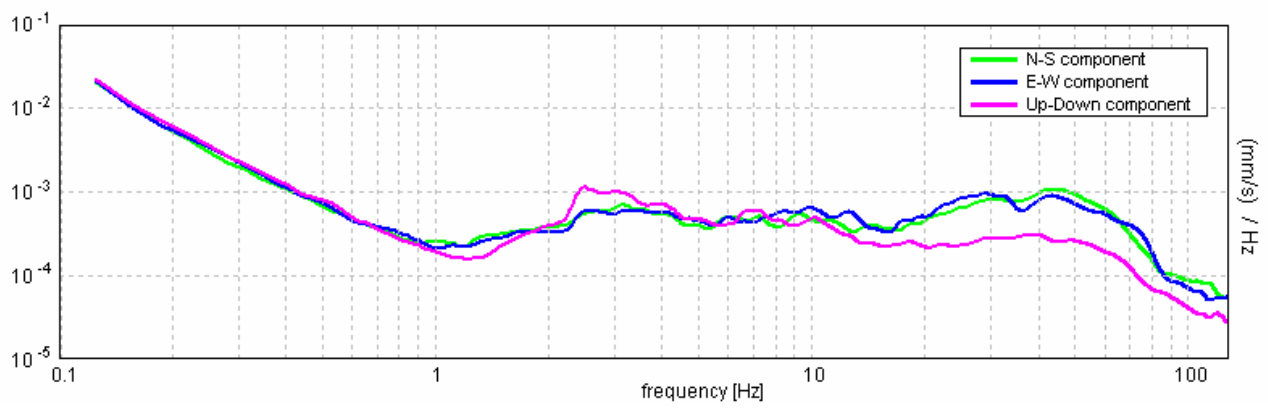
H/V TIME HISTORY



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 44.38 ± 1.69 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$44.38 > 0.50$	OK	
$n_c(f_0) > 200$	$69225.0 > 200$	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 2131 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	18.438 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	117.281 Hz	OK	
$A_0 > 2$	$3.50 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.019 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.84317 < 2.21875$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1304 < 1.58$	OK	

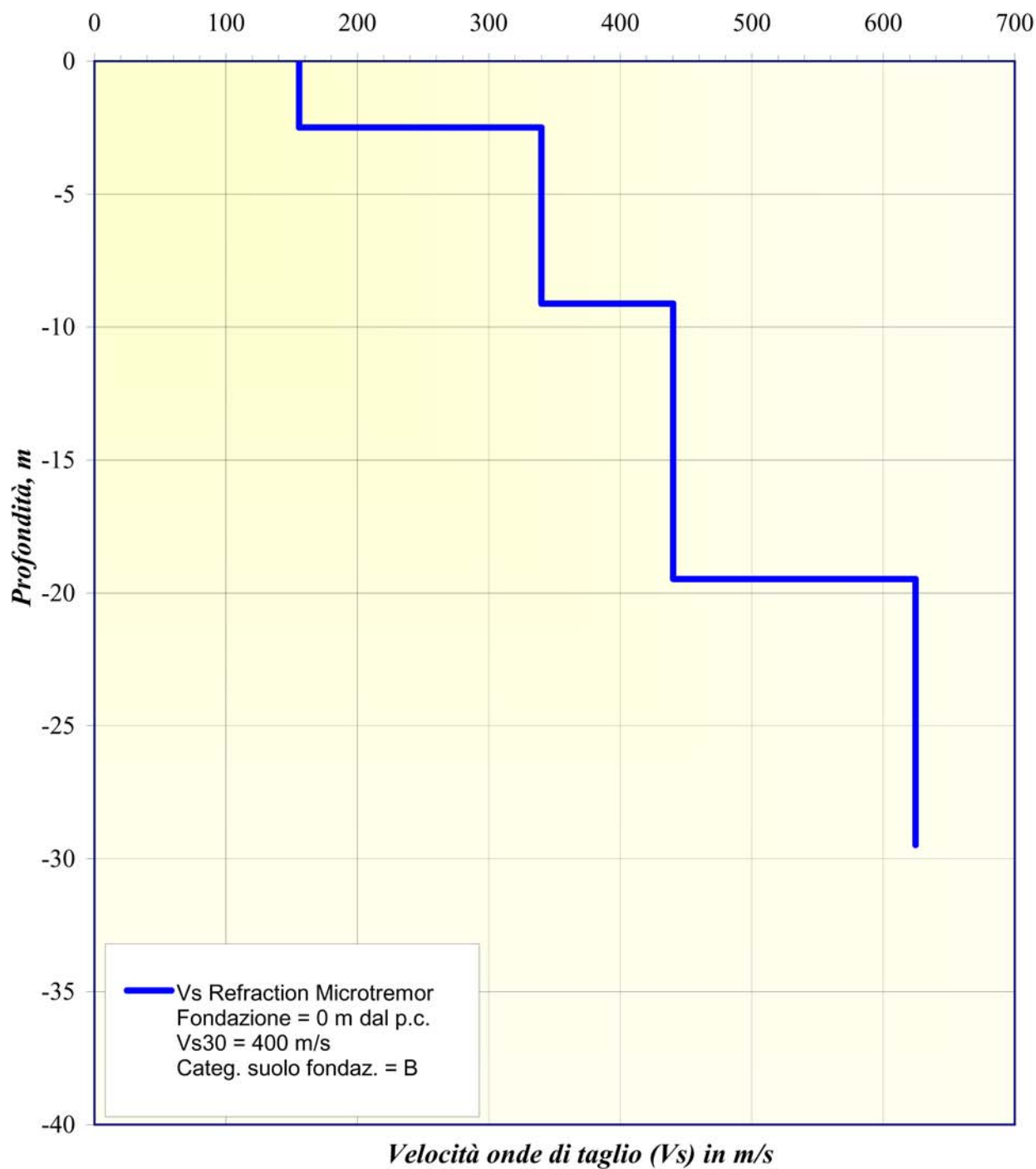
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak 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

Palombata 38

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

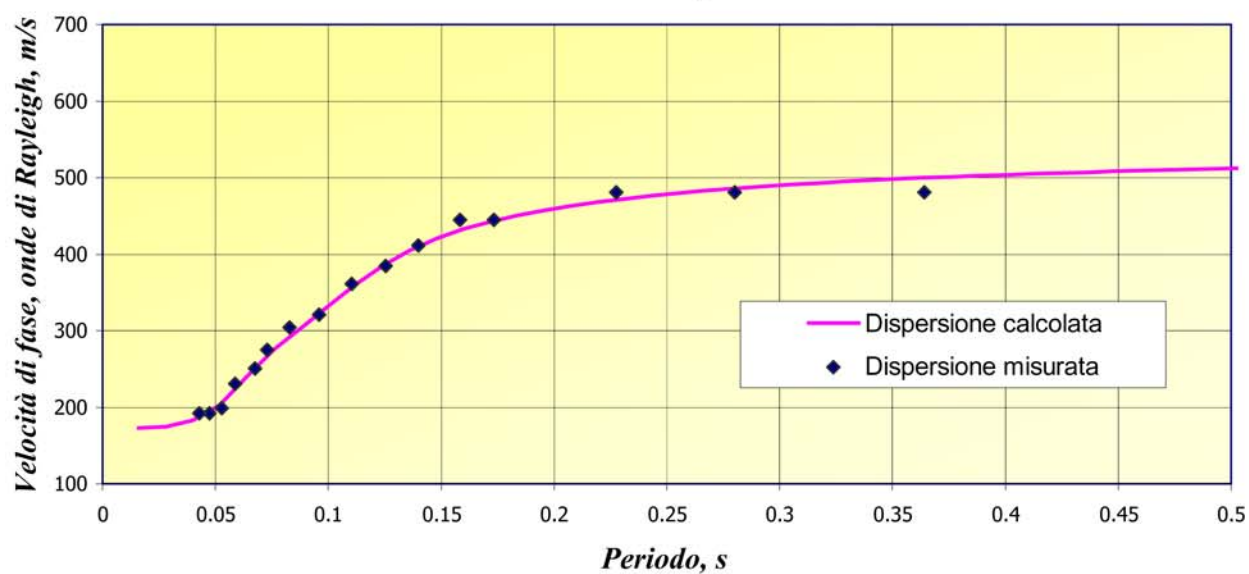
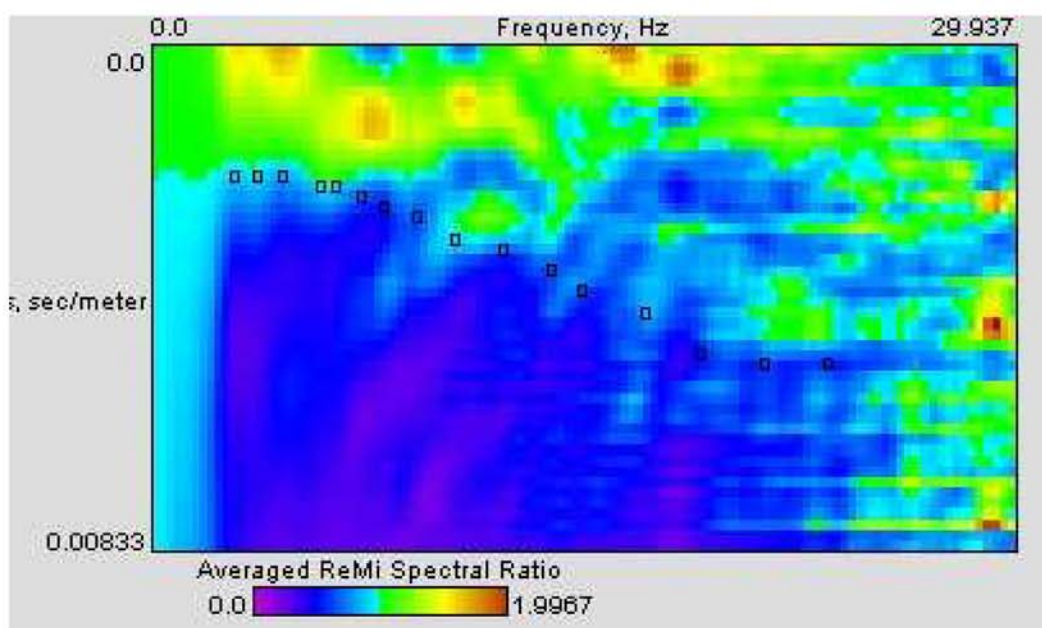
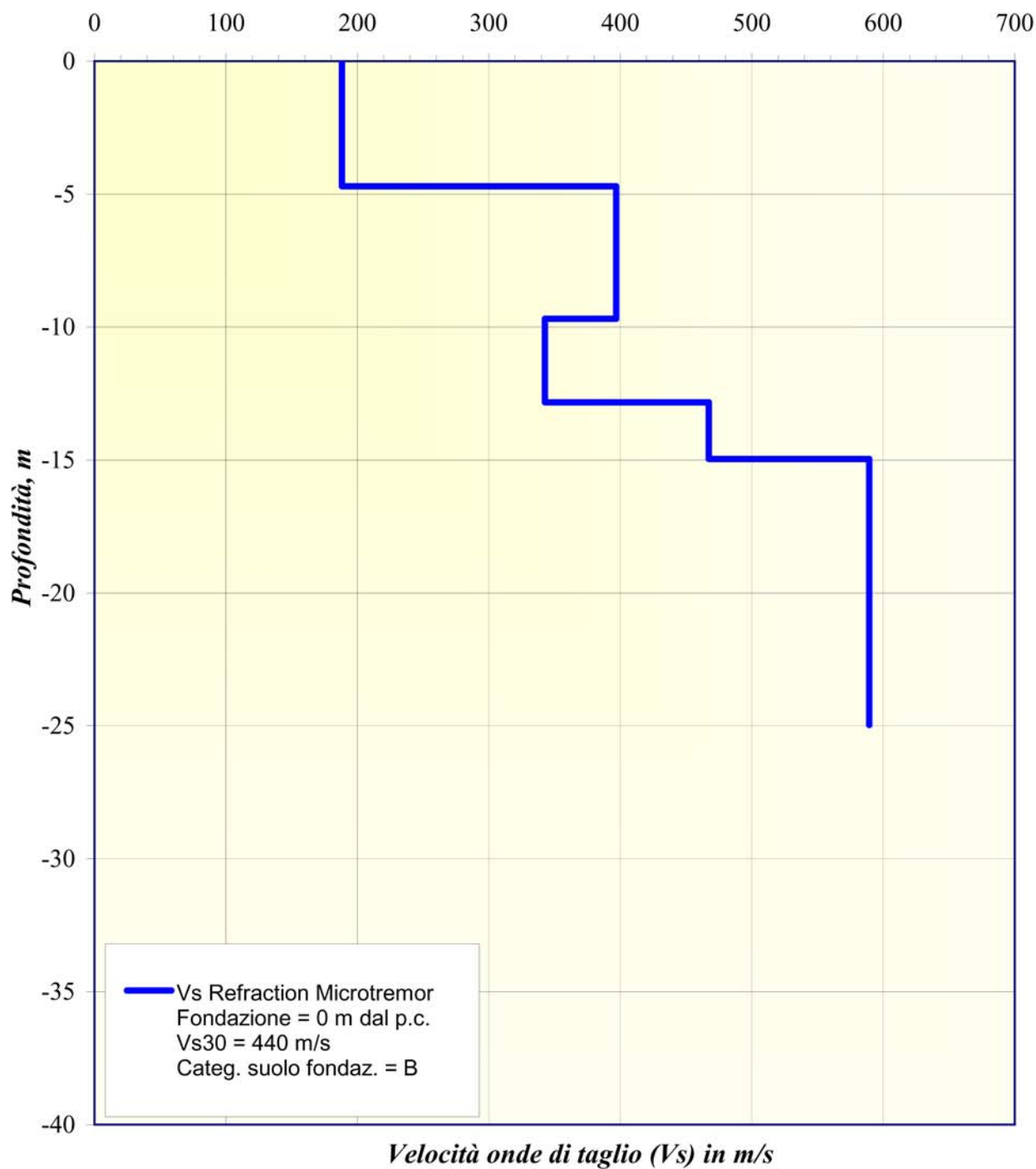


grafico slowness/frequenza



Palombata 38

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

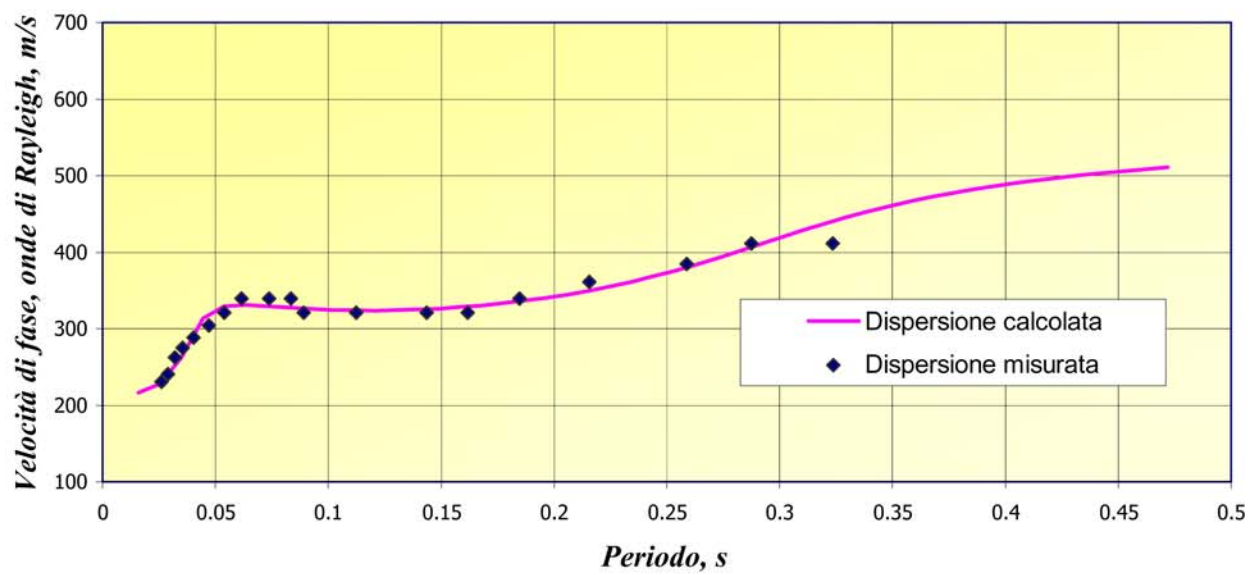
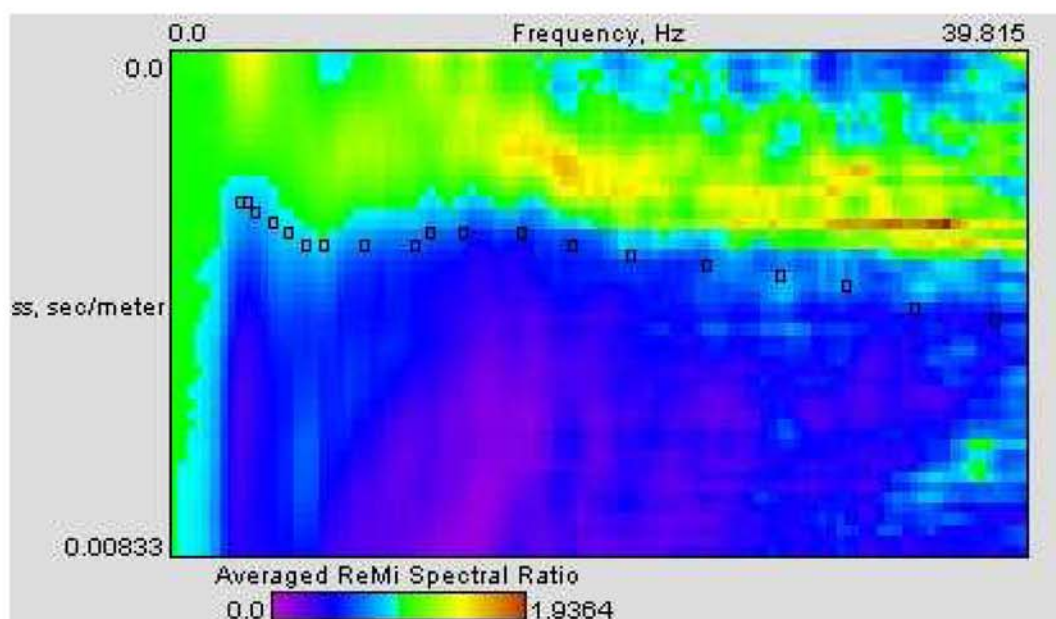
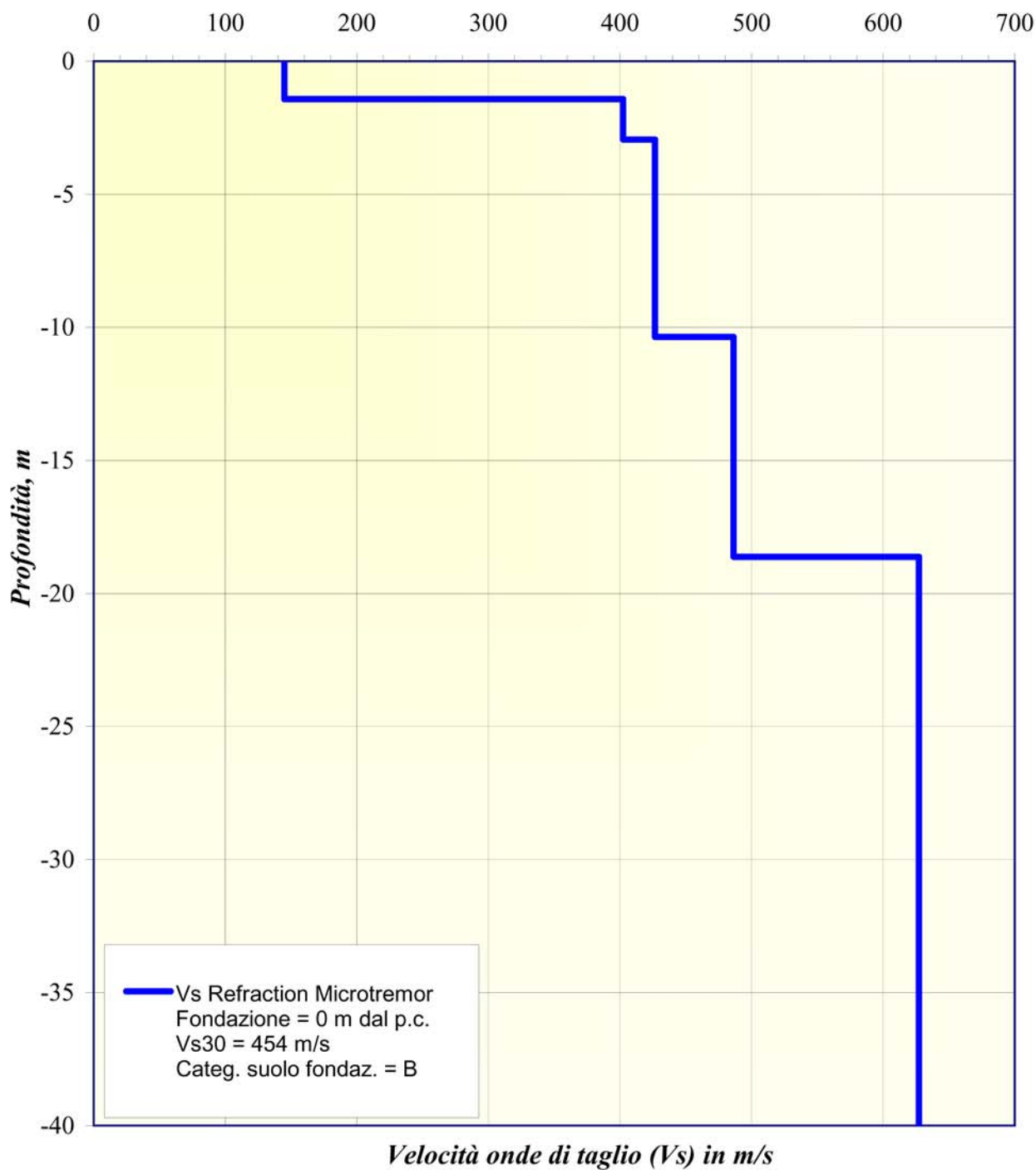


grafico slowness/frequenza



Palombata 40

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

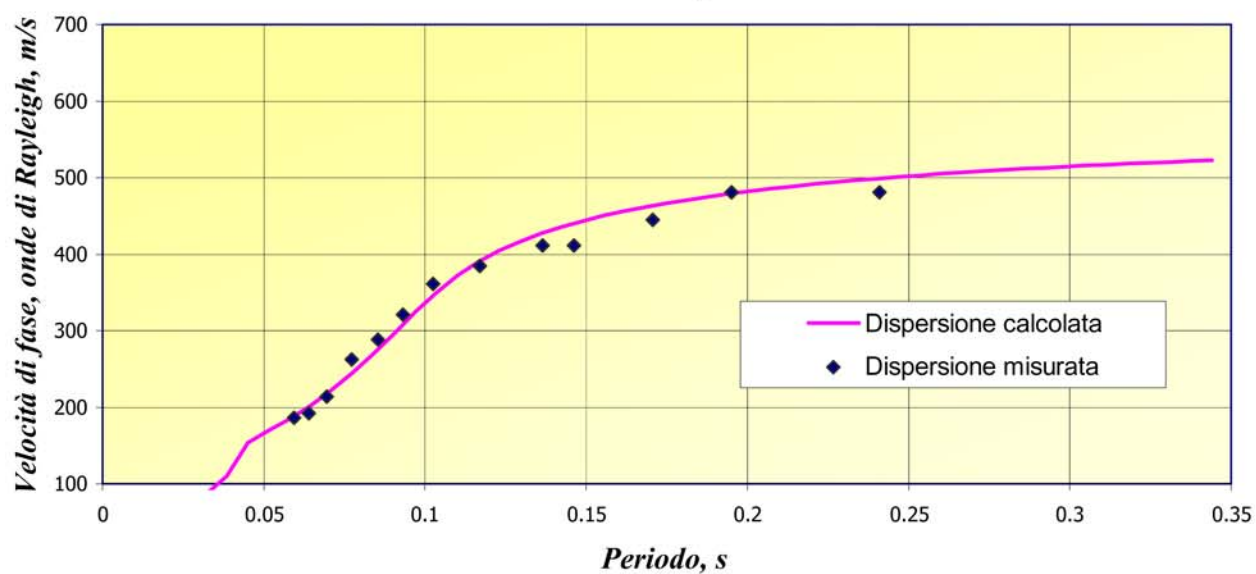
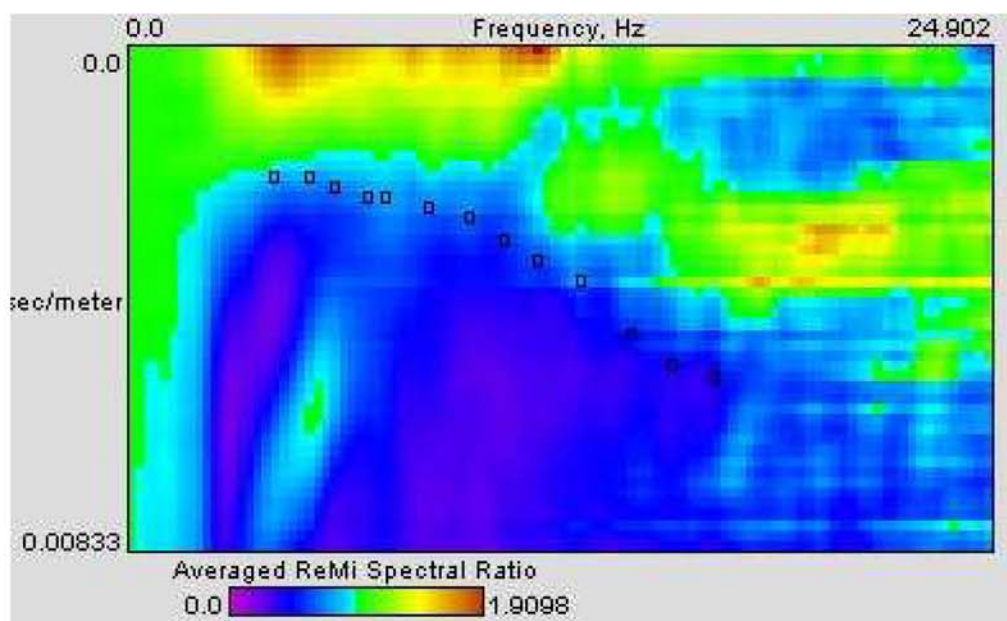
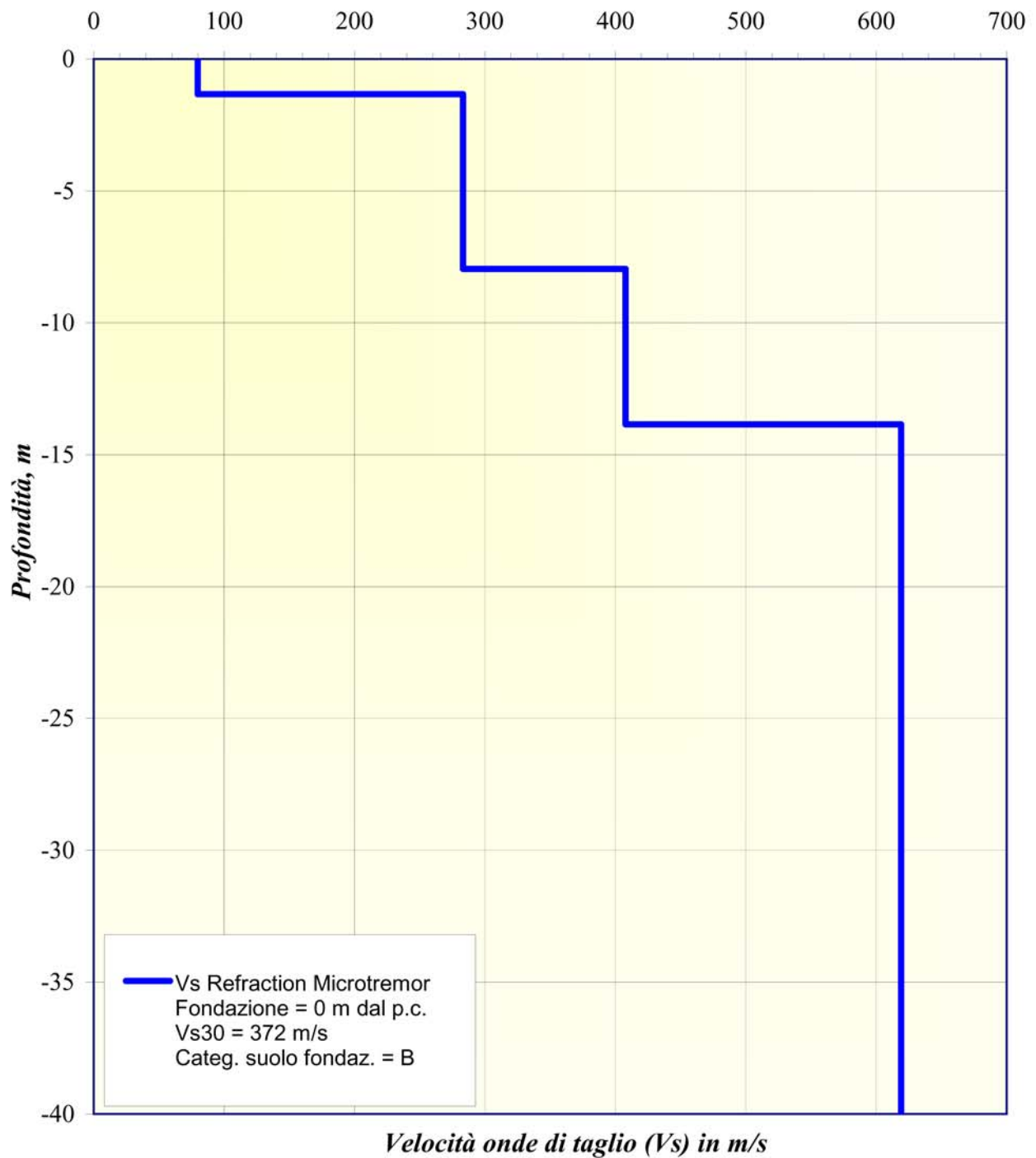


grafico slowness/frequenza



Palombata 38

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

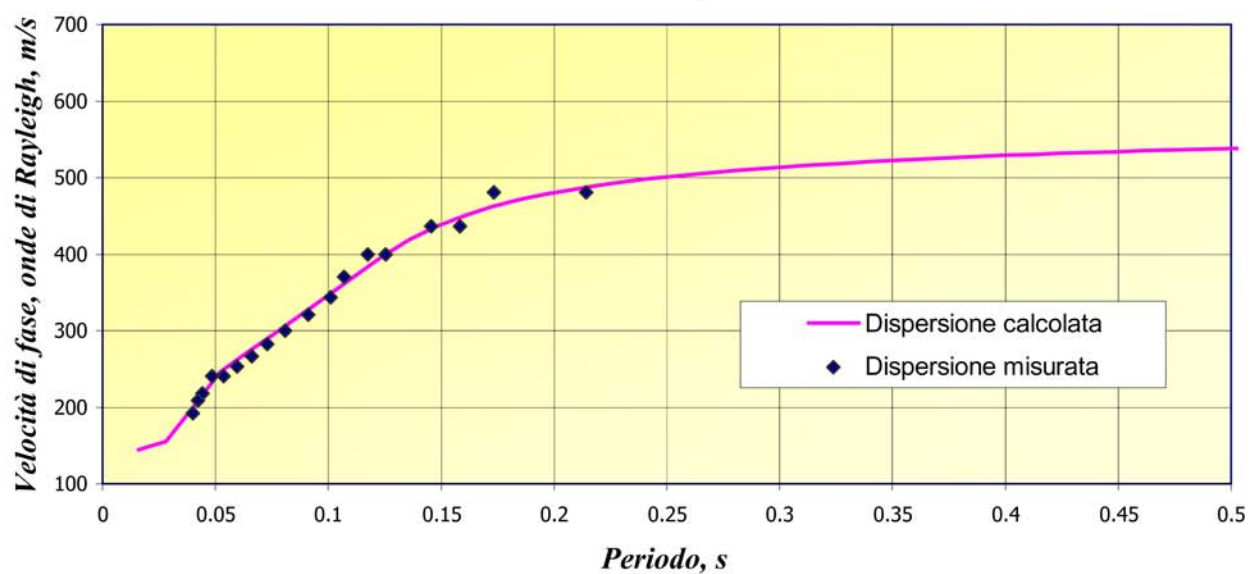
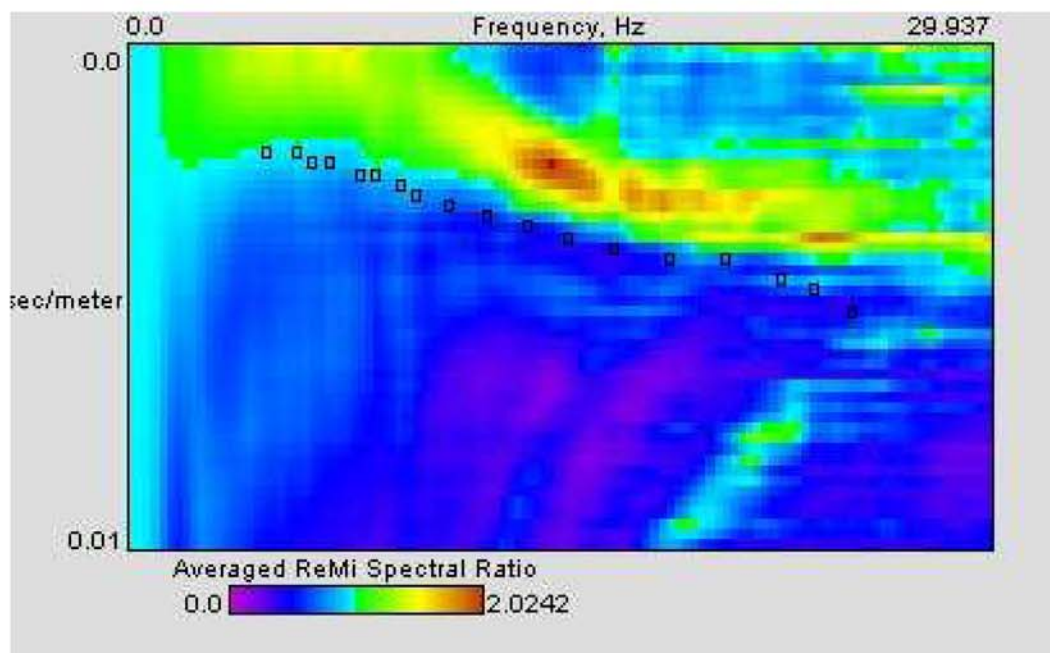


grafico slowness/frequenza



**REGIONE
TOSCANA**



**Direzione Generale delle Politiche
Territoriali e Ambientali
Coordinamento Regionale Prevenzione Sismica**



**MICROZONAZIONE SISMICA
DELLA CONCA AQUILANA
(terremoto 06-04-2009)**

Relazione tecnica finale di sintesi - Macroarea 9

**CIVITA DI BAGNO - PROVE MASW E
SISMICA PASSIVA (REMI)**

	indagine ReMi		indagine H/V		
nome	Civita1 (25)				
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	185	5.7			
2° livello	401	17.7			
3° livello	612	35			
4° livello	478				
5° livello					
6° livello					
Vs 30	332				

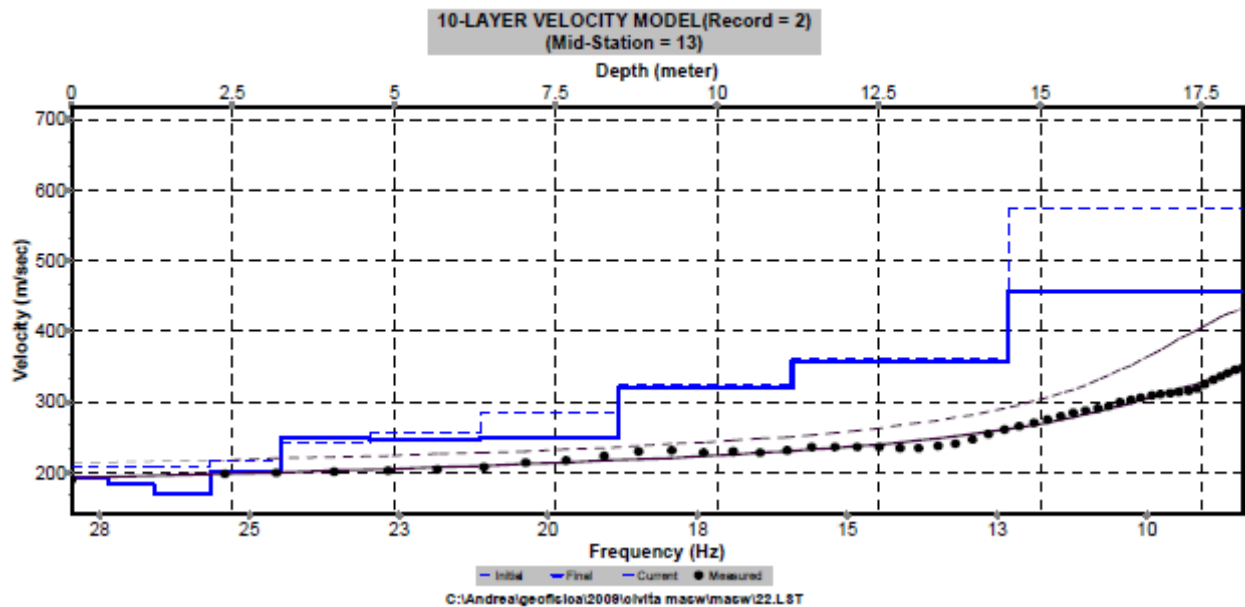
	indagine ReMi		indagine H/V		
nome	Civita 2 (22)				
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	185	7			
2° livello	323	19			
3° livello	348	36.4			
4° livello	393				
5° livello					
6° livello					
Vs 30	282				

	indagine ReMi		indagine H/V		
nome	Civita 3 (24)				
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	169	4			
2° livello	291	16			
3° livello	360	35.7			
4° livello	417				
5° livello					
6° livello					
Vs 30	289				

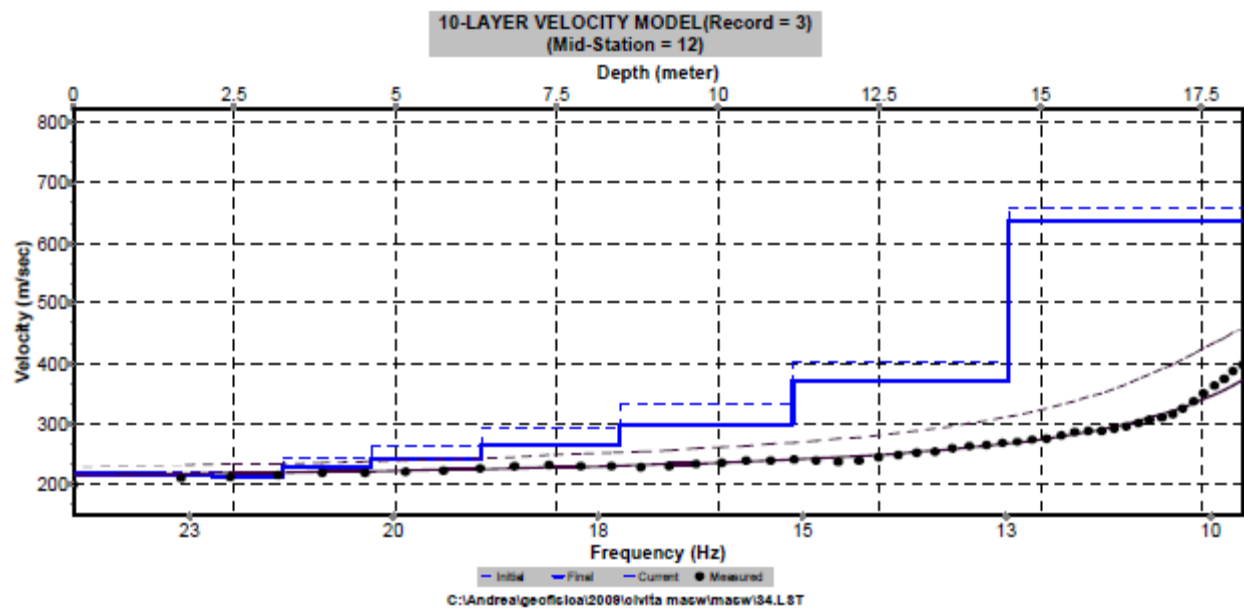
	indagine ReMi		indagine H/V		
nome	Civita masw (42)		Civita masw (42)		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	141	5.5			
2° livello	353	14			
3° livello	275	16.9			
4° livello	535	27.2			
5° livello	345	51.3			
6° livello	550				
Vs 30	296		2.2	314	35.7
			Classe misura		A

MASW Civita Bagno 42

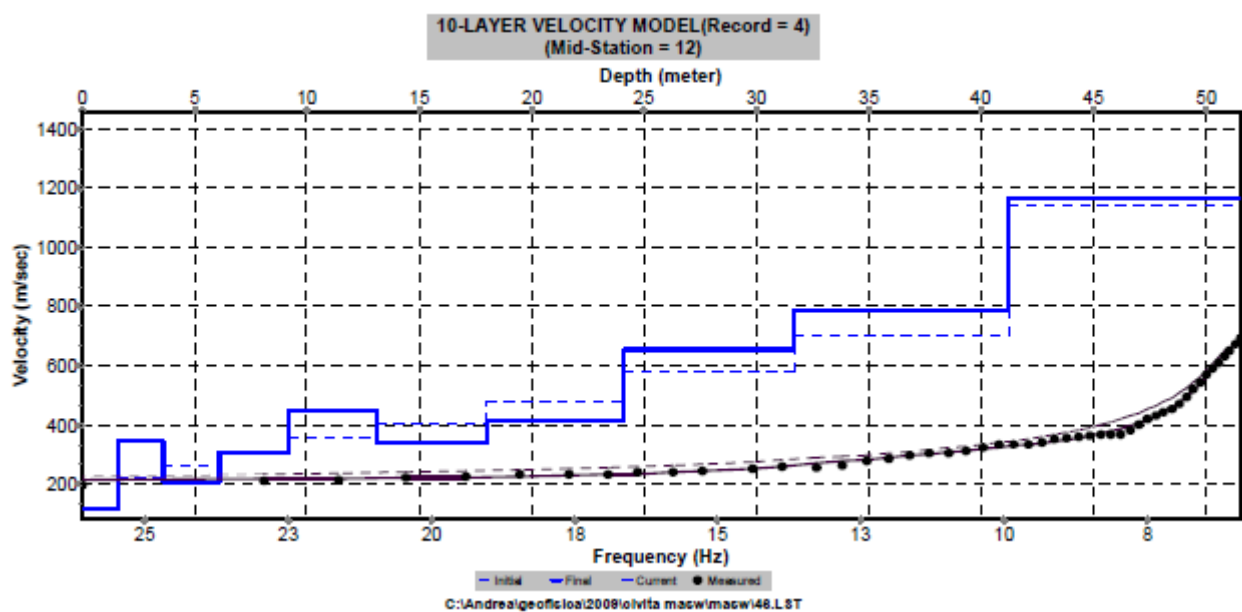
Offset 2 m



offset 4 m

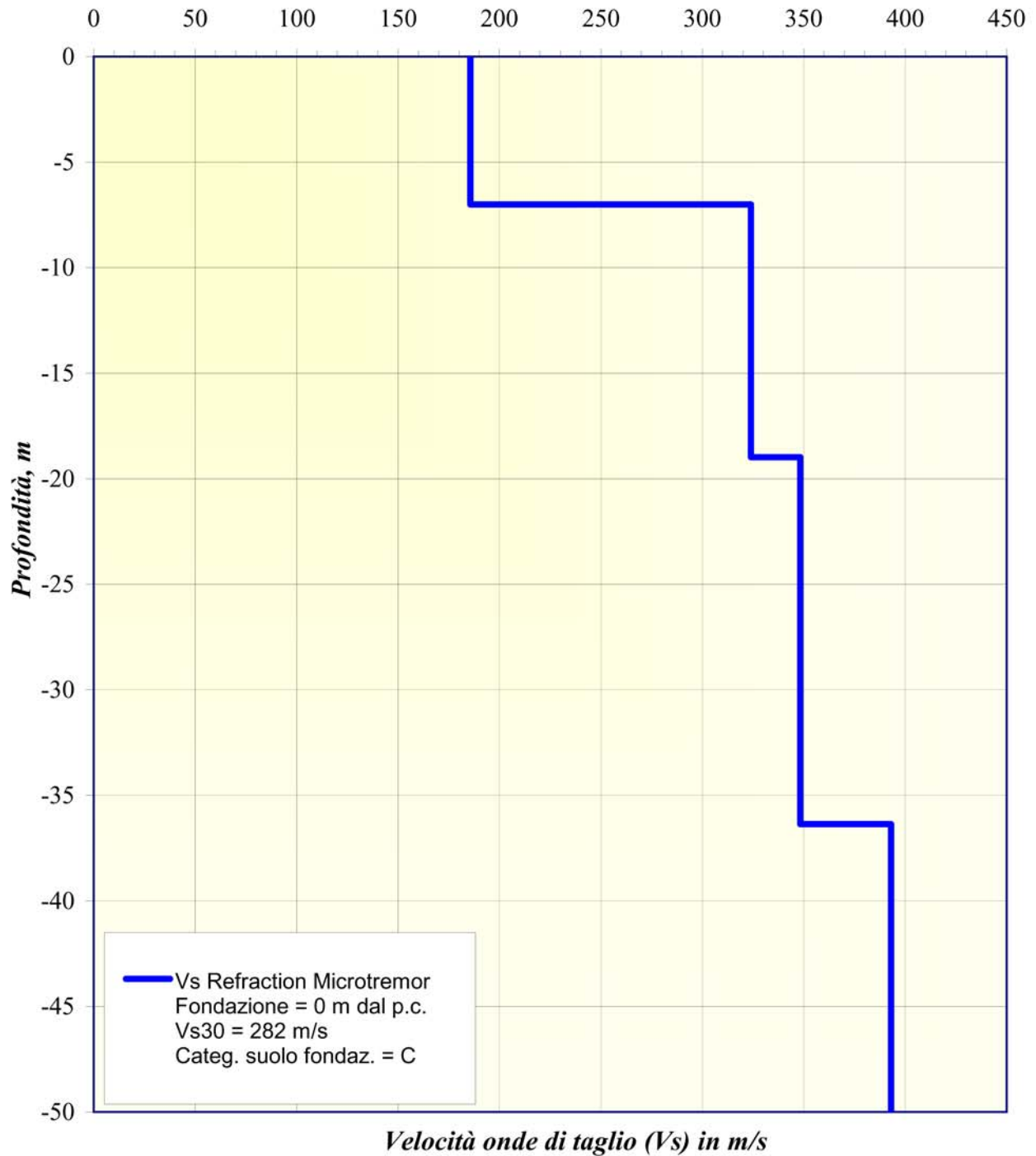


offset 6 m



Civita22

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

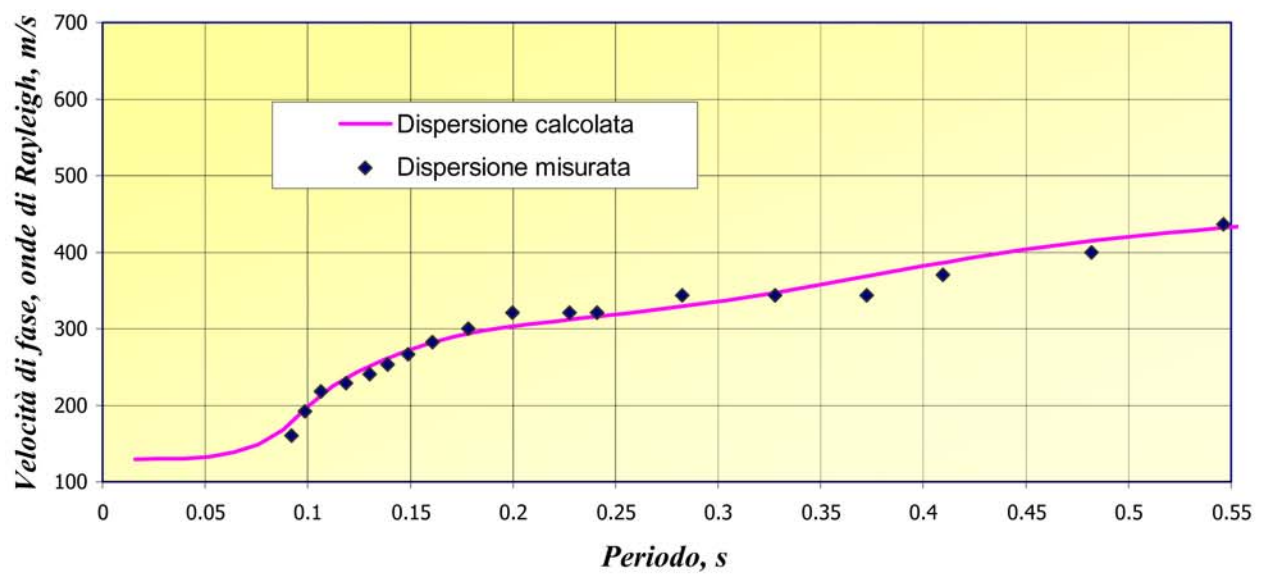
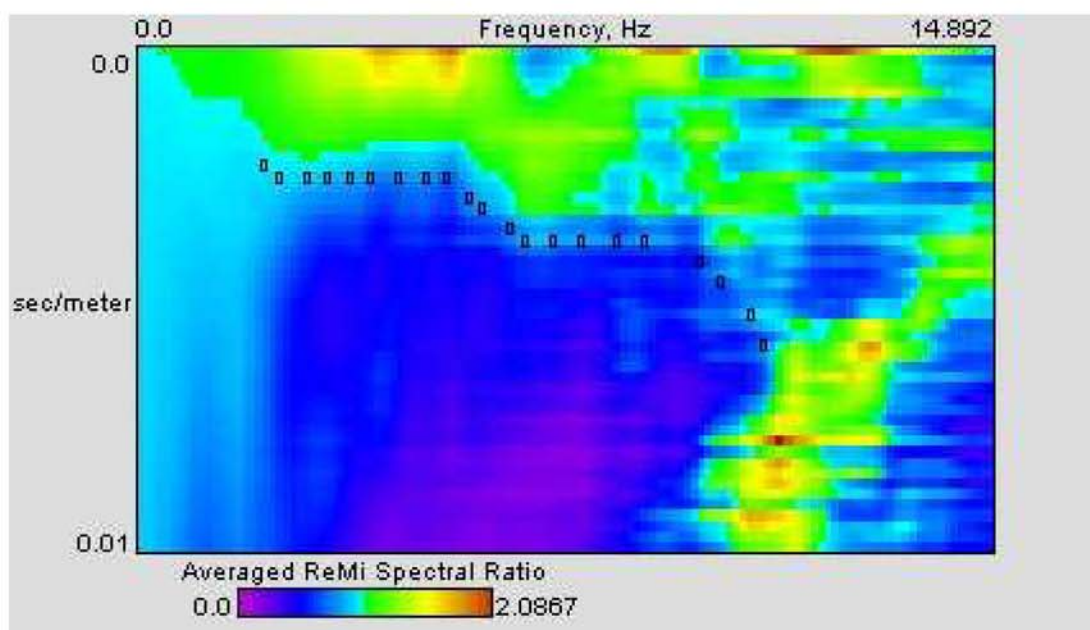
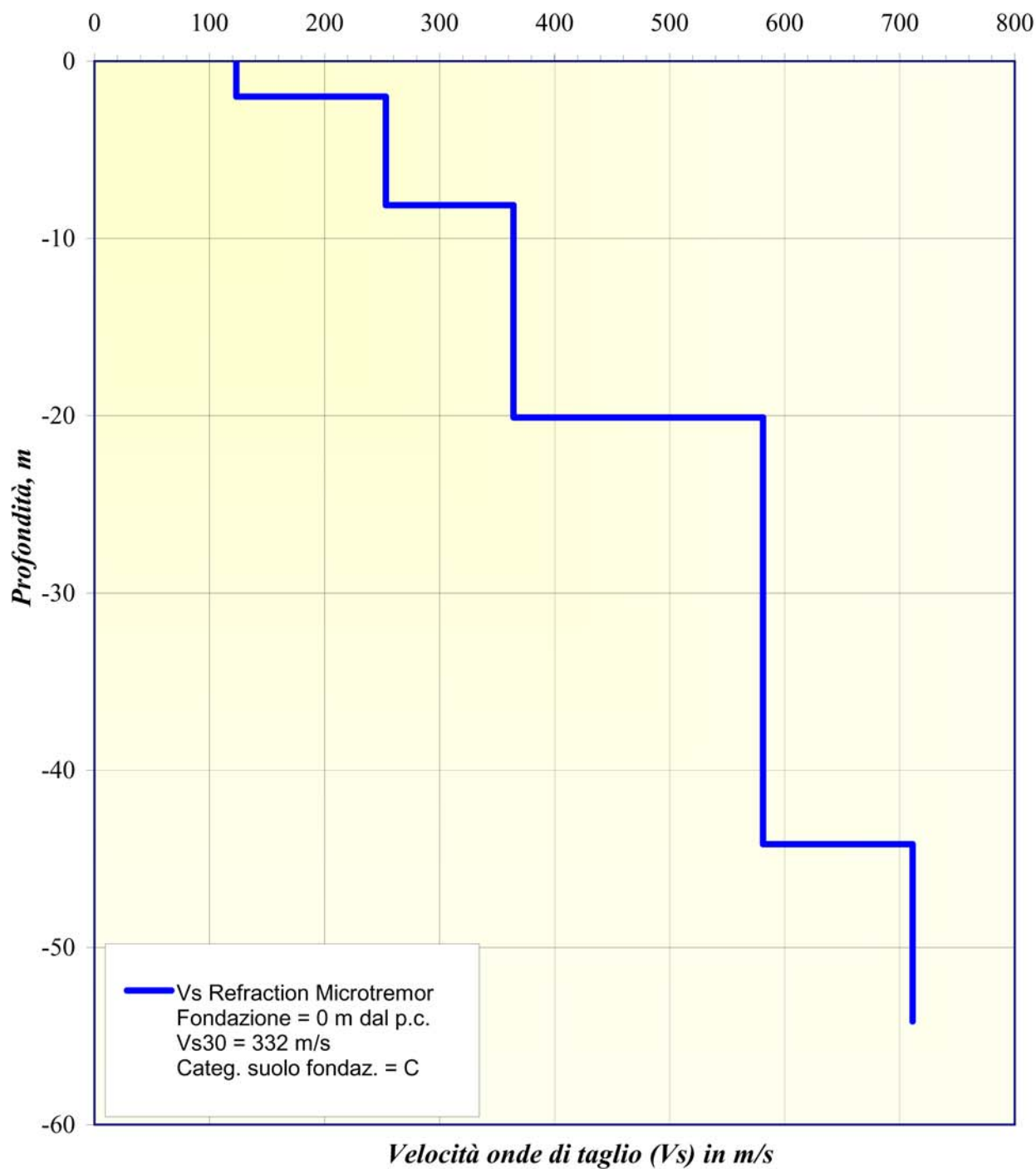


grafico slowness/frequenza



Civita 42

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

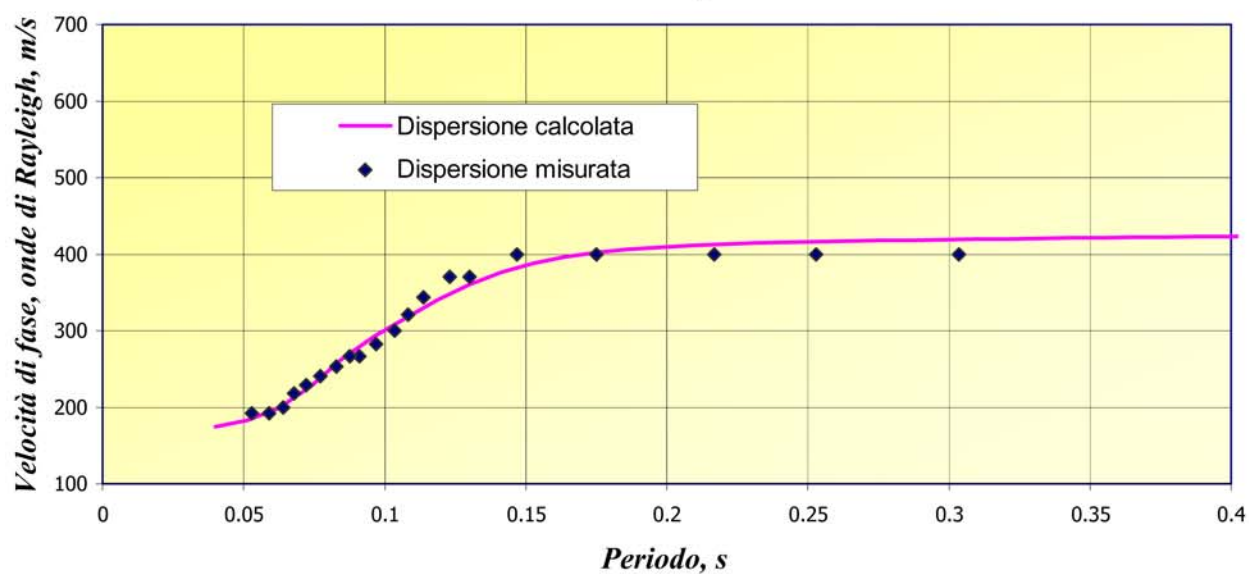
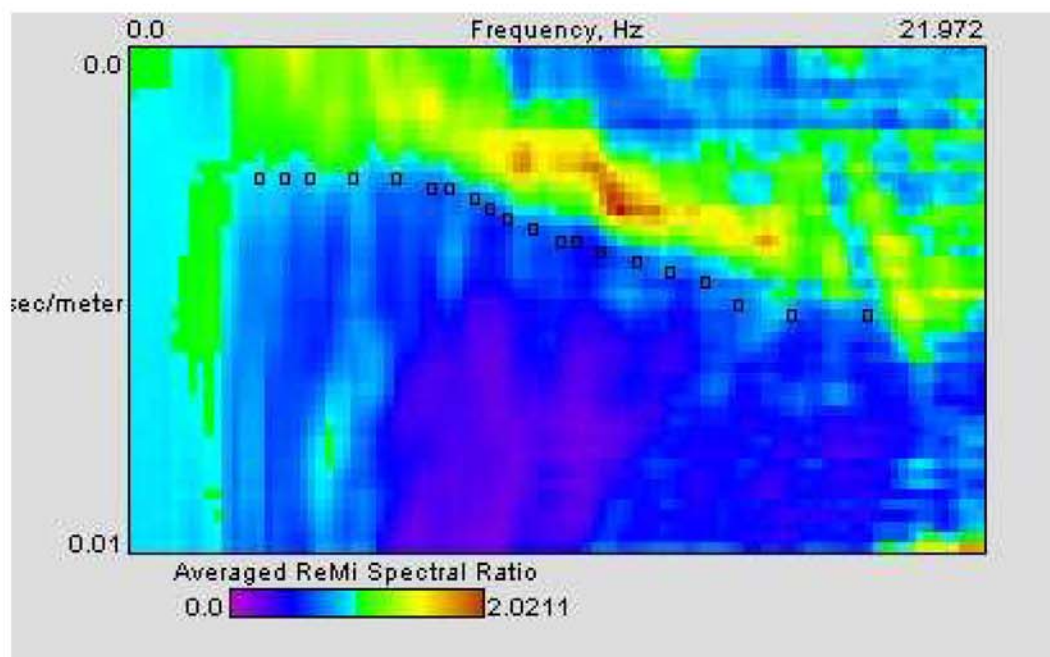
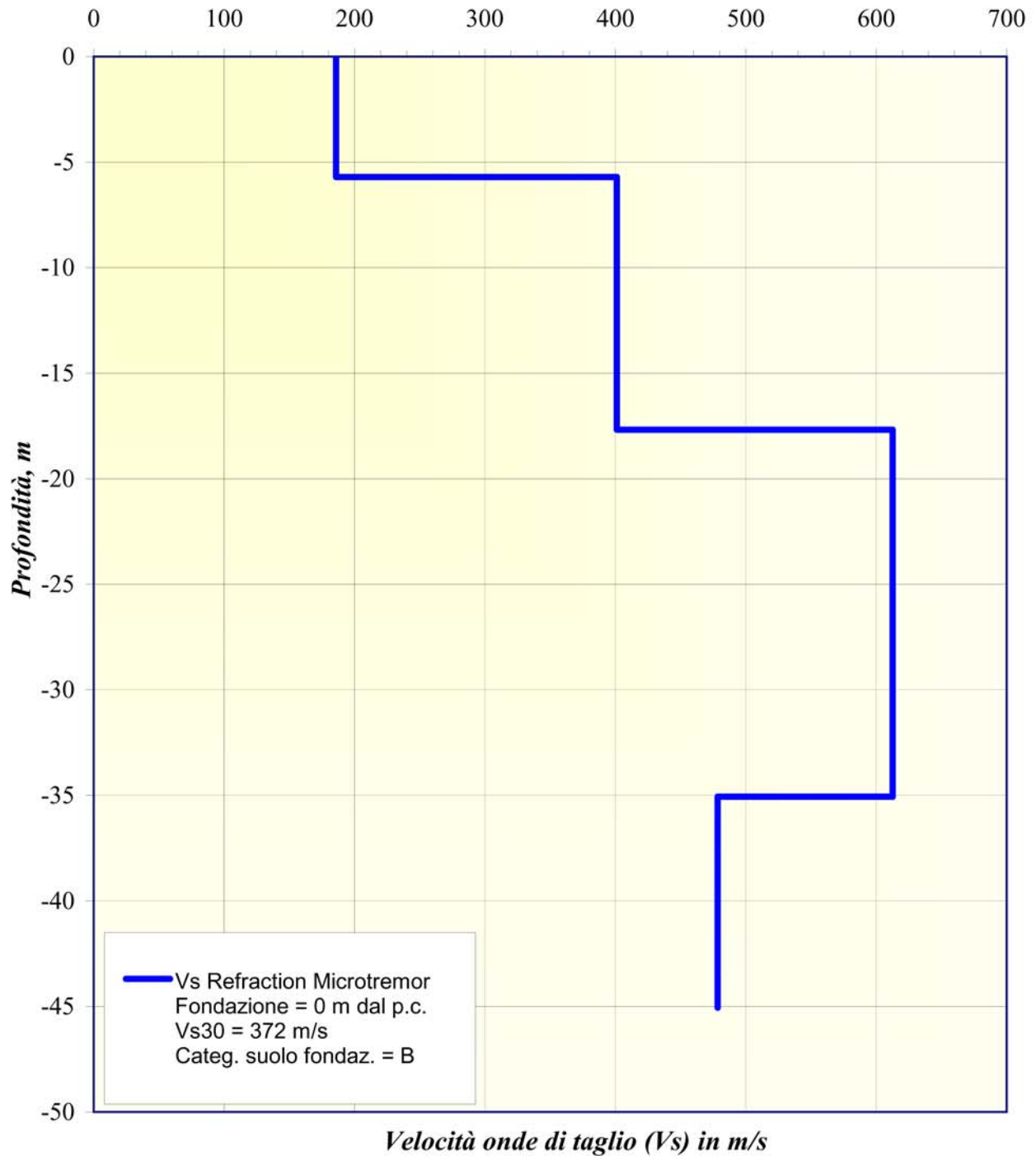


grafico slowness/frequenza



Civita 25

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

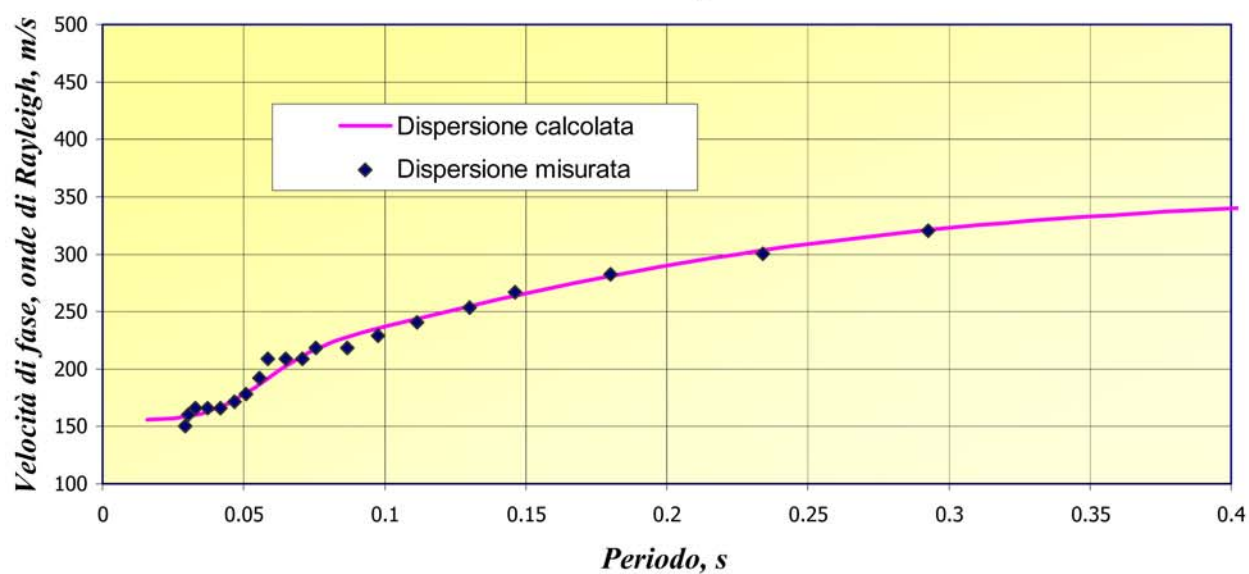
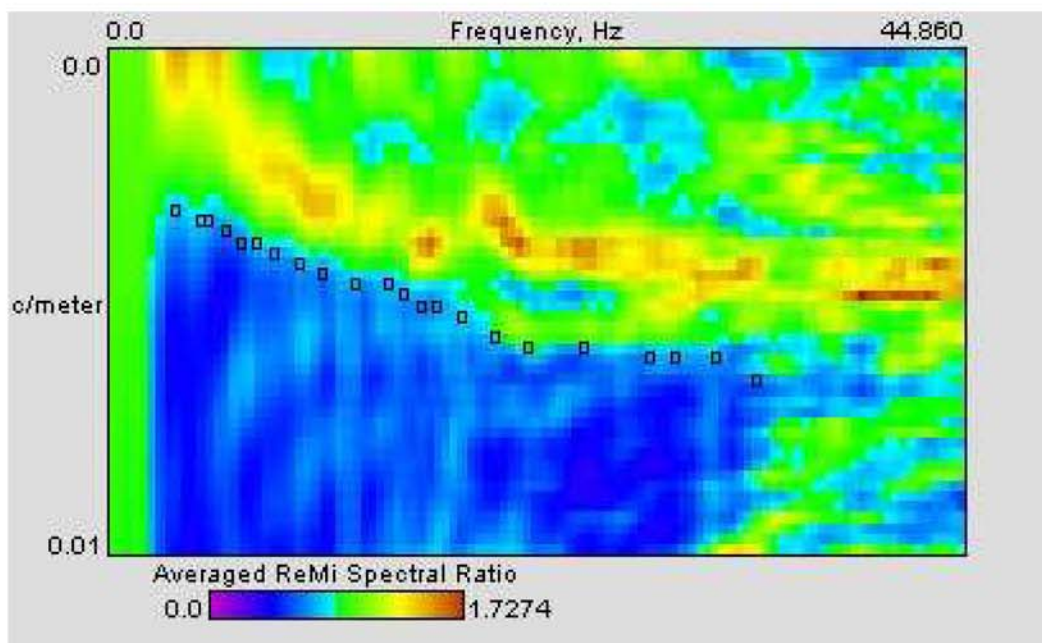
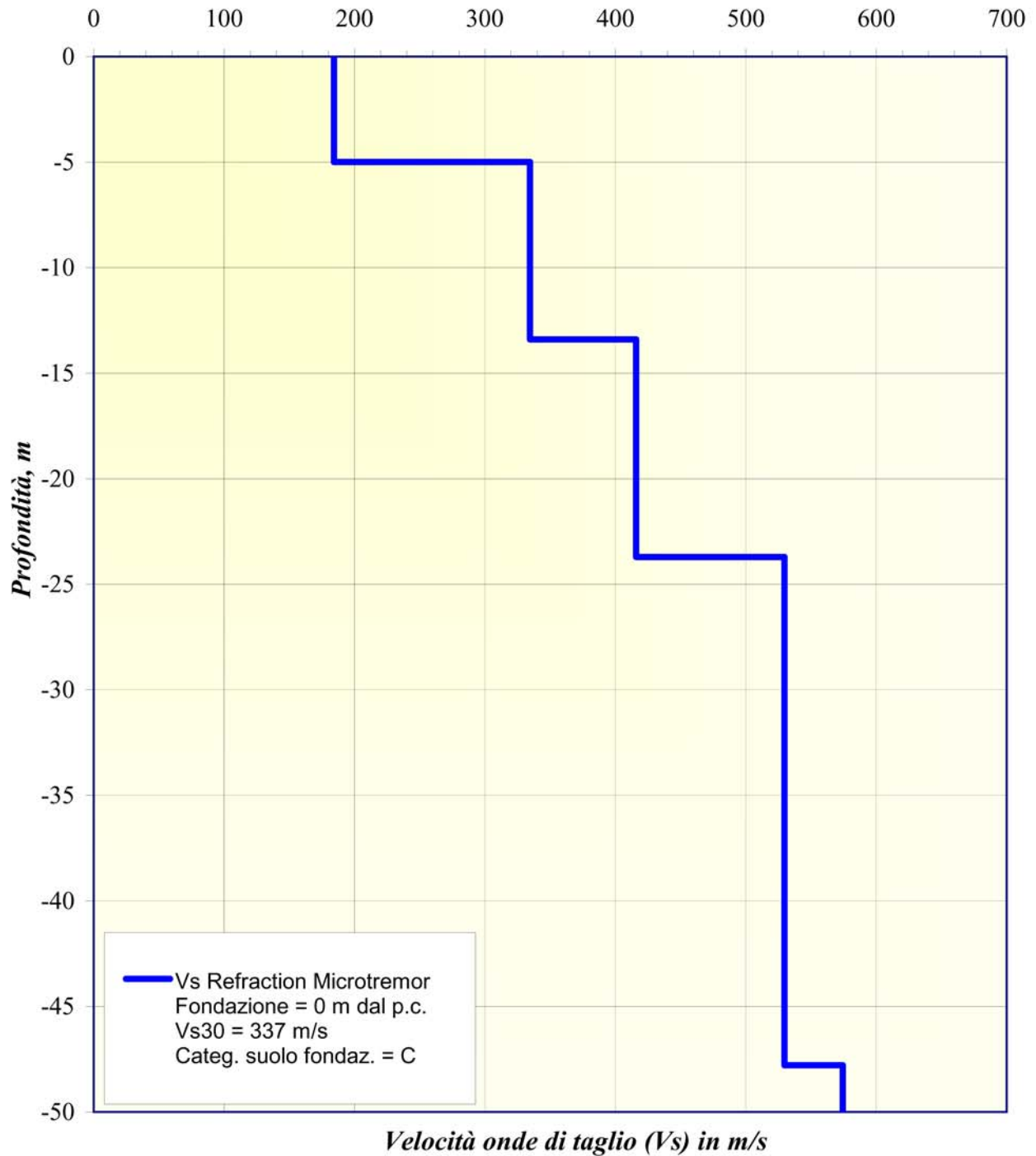


grafico slowness/frequenza



Civita 24

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

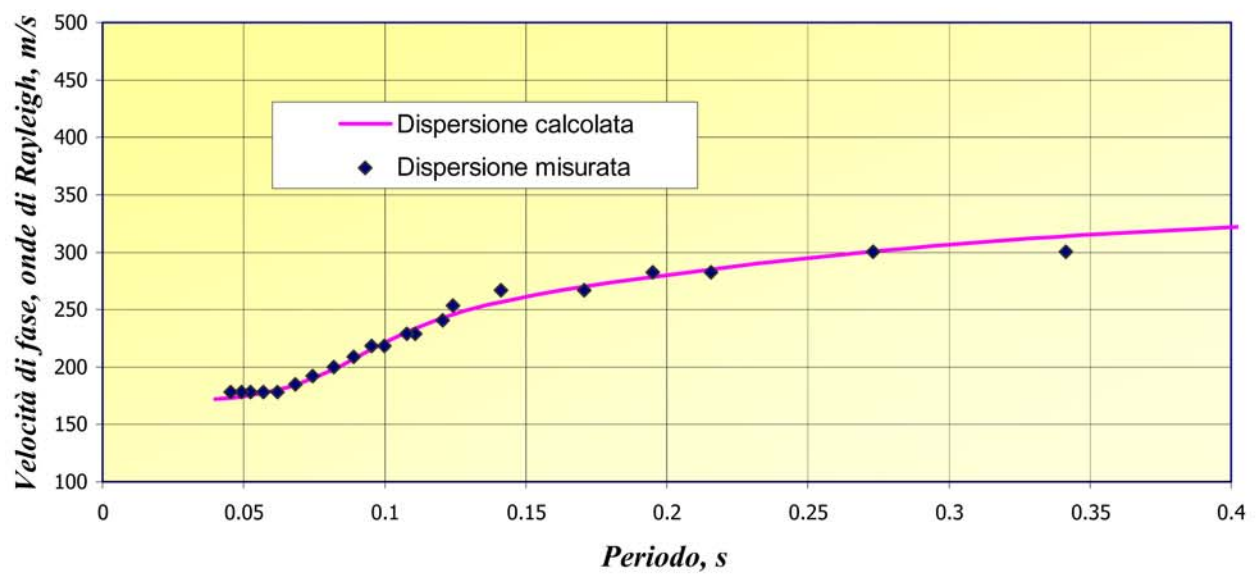
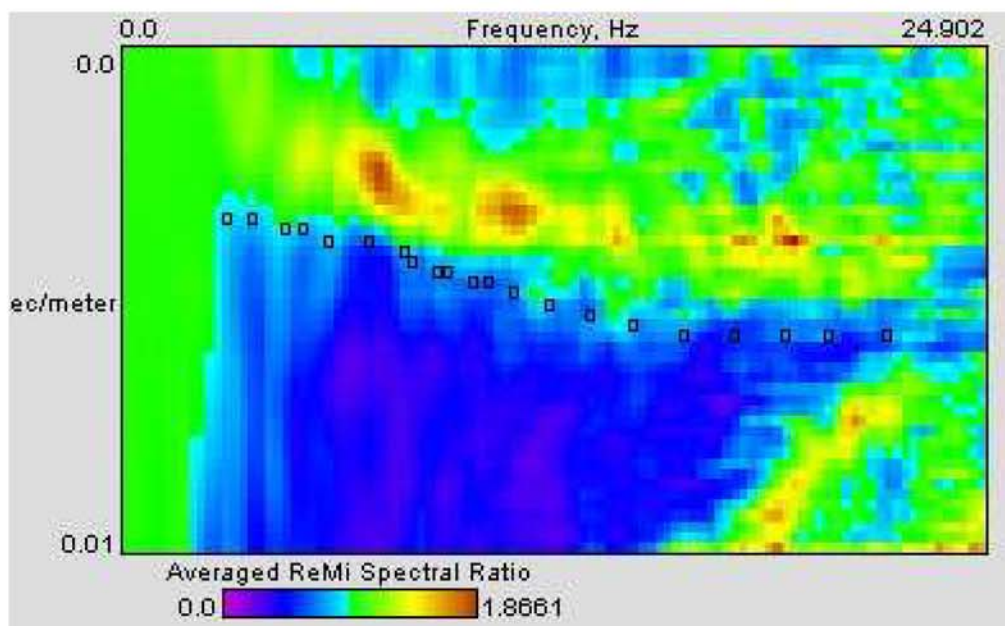


grafico slowness/frequenza



**REGIONE
TOSCANA**



**Direzione Generale delle Politiche
Territoriali e Ambientali
Coordinamento Regionale Prevenzione Sismica**



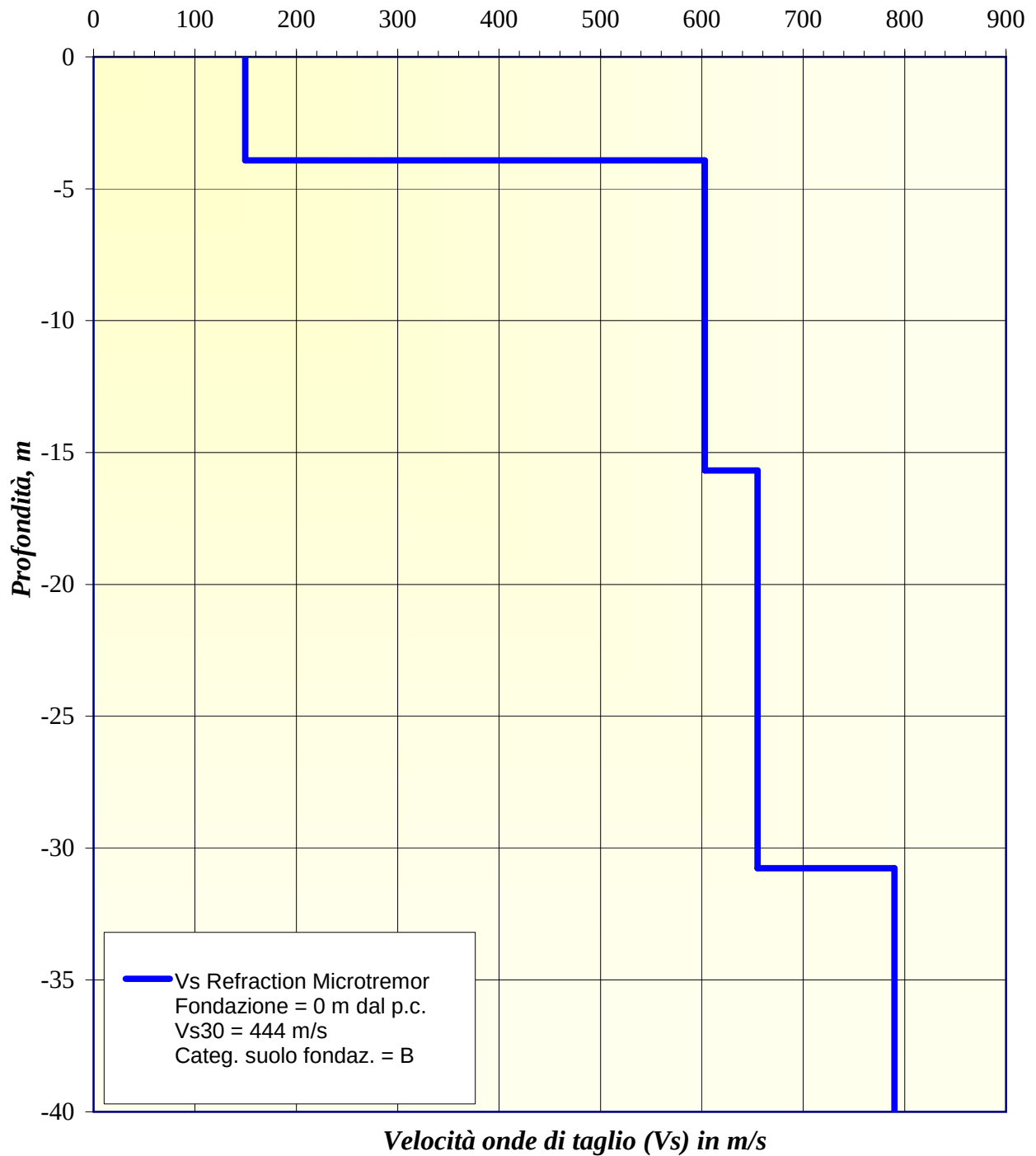
**MICROZONAZIONE SISMICA
DELLA CONCA AQUILANA
(terremoto 06-04-2009)**

Relazione tecnica finale di sintesi - Macroarea 9

**SAN BENEDETTO - PROVE MASW E
SISMICA PASSIVA (REMI)**

S. Benedetto 26

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

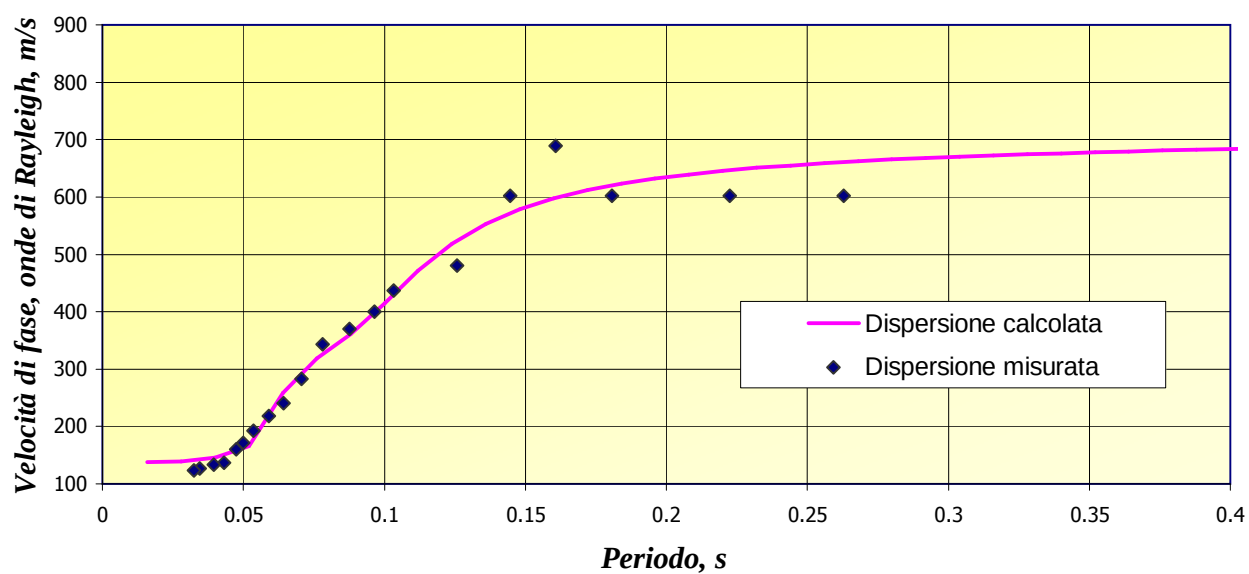
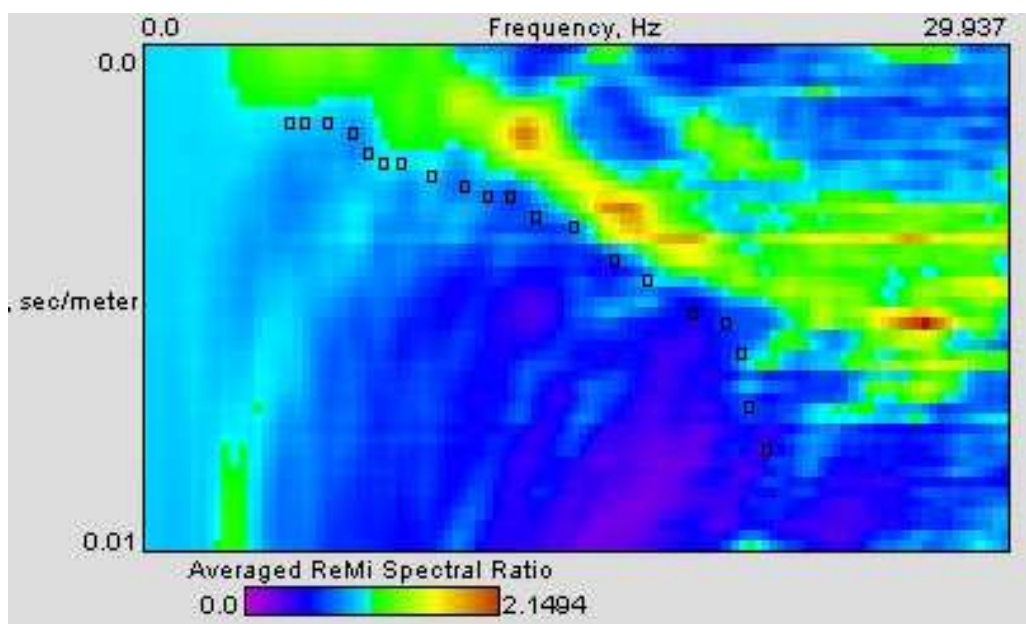
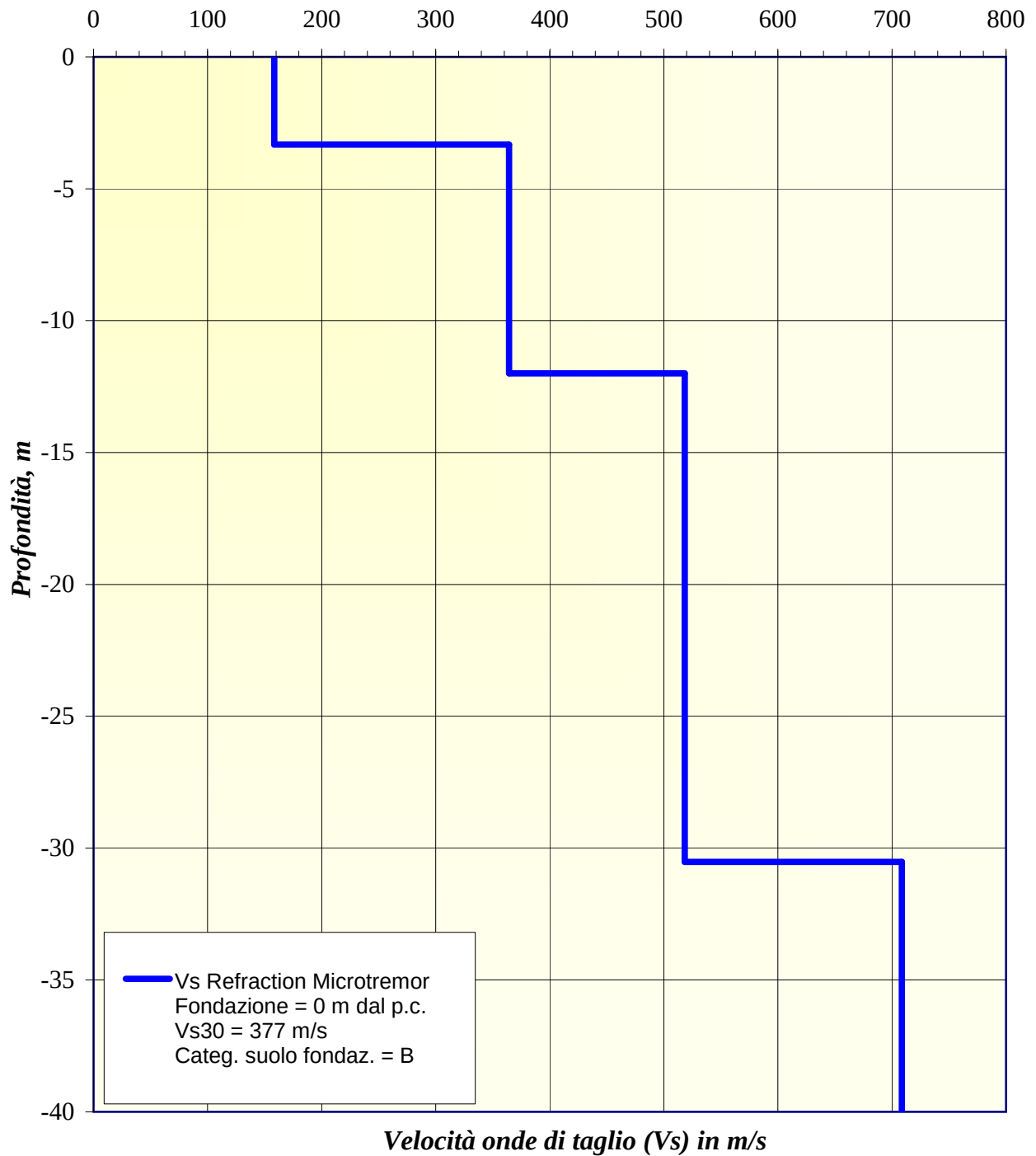


grafico slowness/frequenza



S. Benedetto 28

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



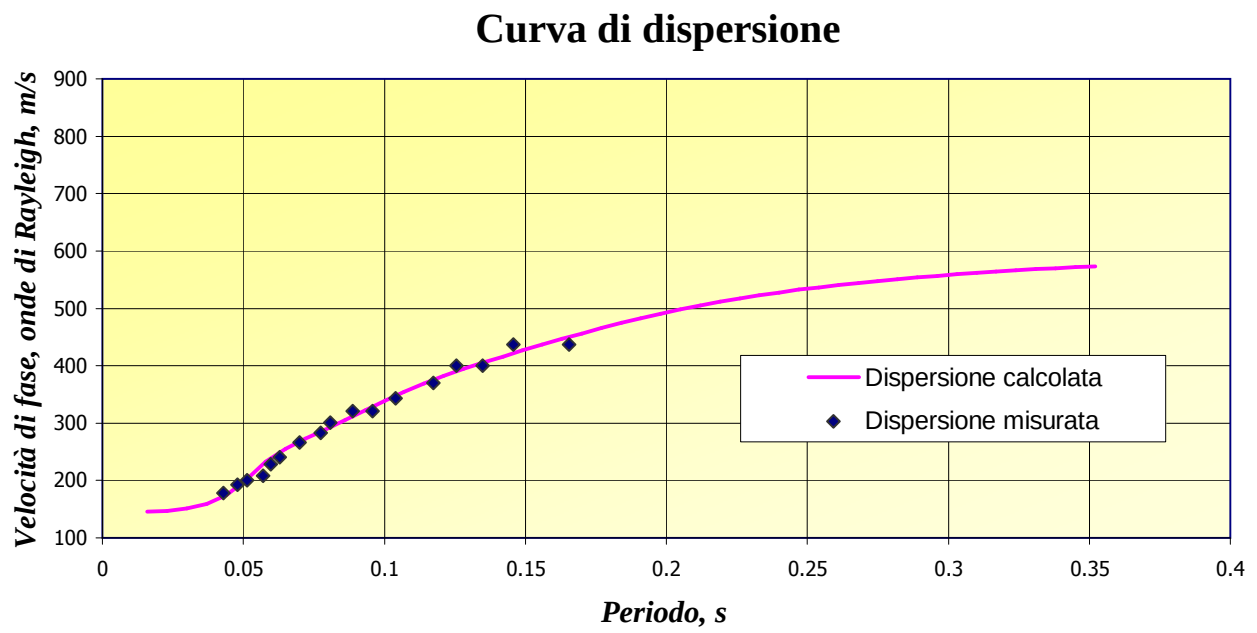


grafico slowness/frequenza

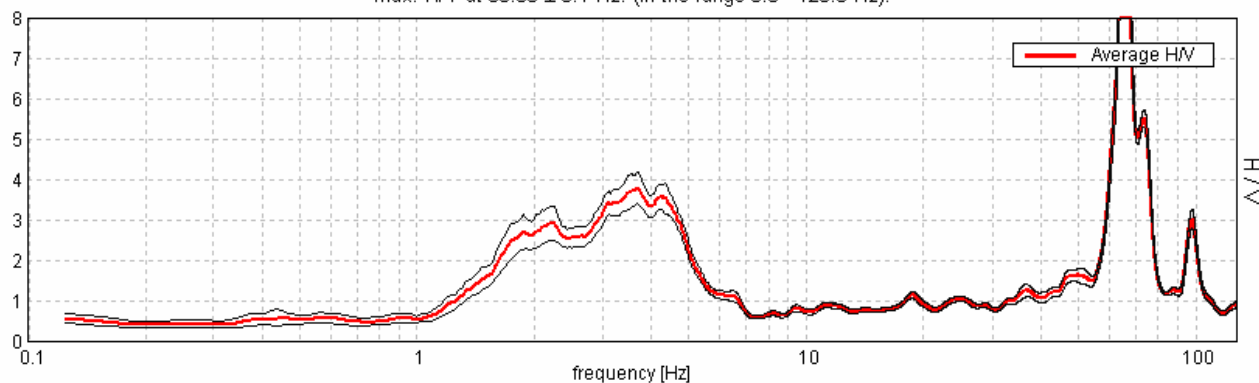
CIVITA 42

Start recording: 22/07/09 16:28:37 End recording: 22/07/09 16:54:38
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

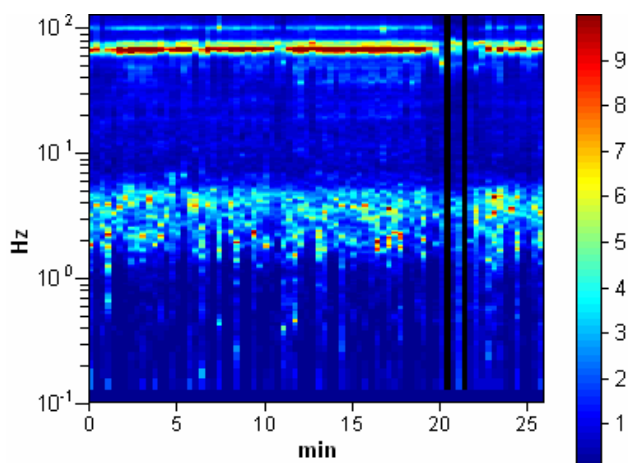
Trace length: 0h26'00". Analyzed 97% trace (manual window selection)
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

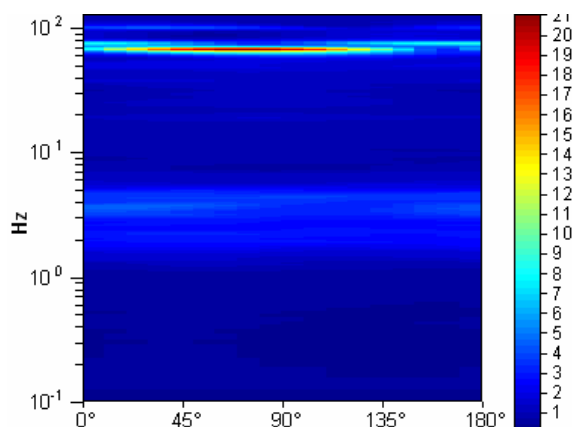
Max. H/V at 66.06 ± 0.1 Hz. (in the range 0.0 - 128.0 Hz).



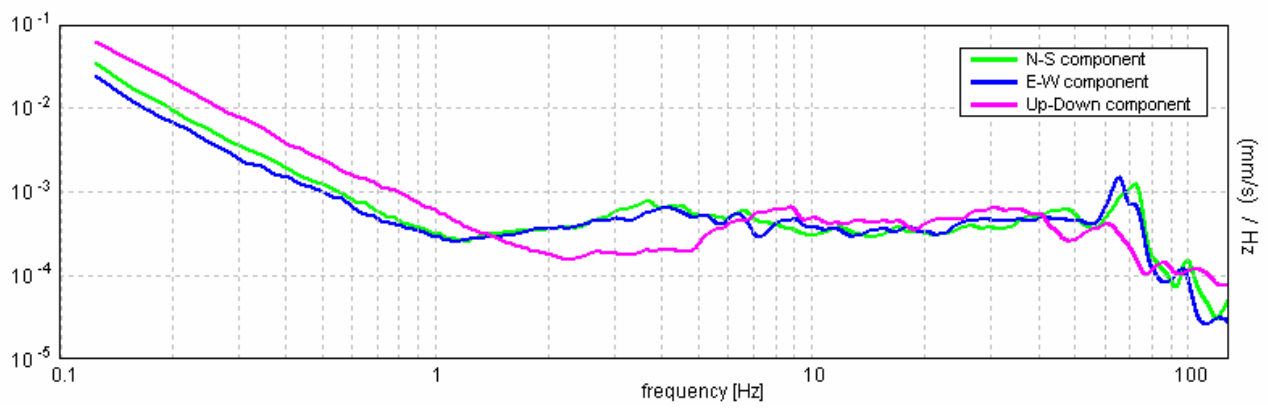
H/V TIME HISTORY



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 66.06 ± 0.1 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	66.06 > 0.50	OK	
$n_c(f_0) > 200$	100415.0 > 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 3040 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	62.5 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	69.031 Hz	OK	
$A_0 > 2$	12.97 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00074 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.049 < 3.30313$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.6048 < 1.58$	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

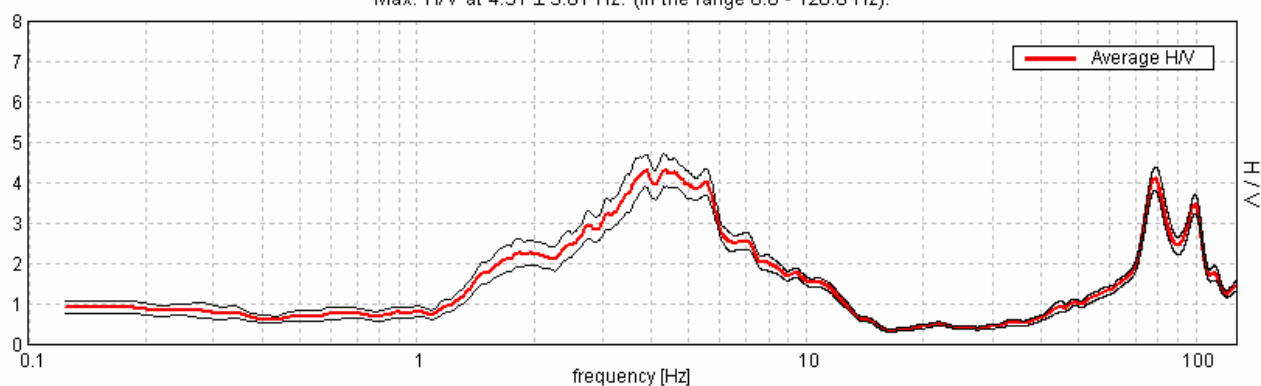
S_BENEDETTO, 26

Start recording: 21/07/09 10:49:06 End recording: 21/07/09 11:15:07
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

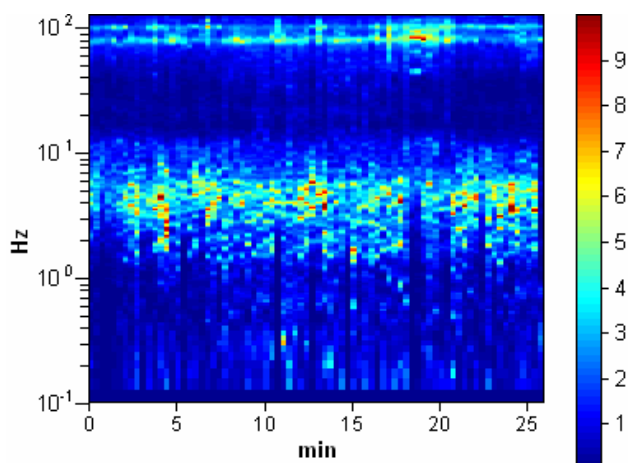
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

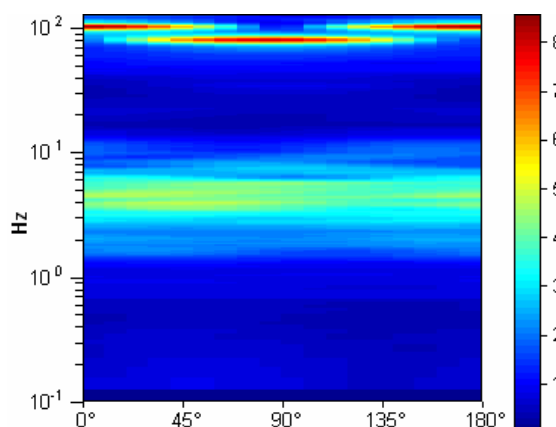
Max. H/V at 4.31 ± 3.61 Hz. (in the range 0.0 - 128.0 Hz).



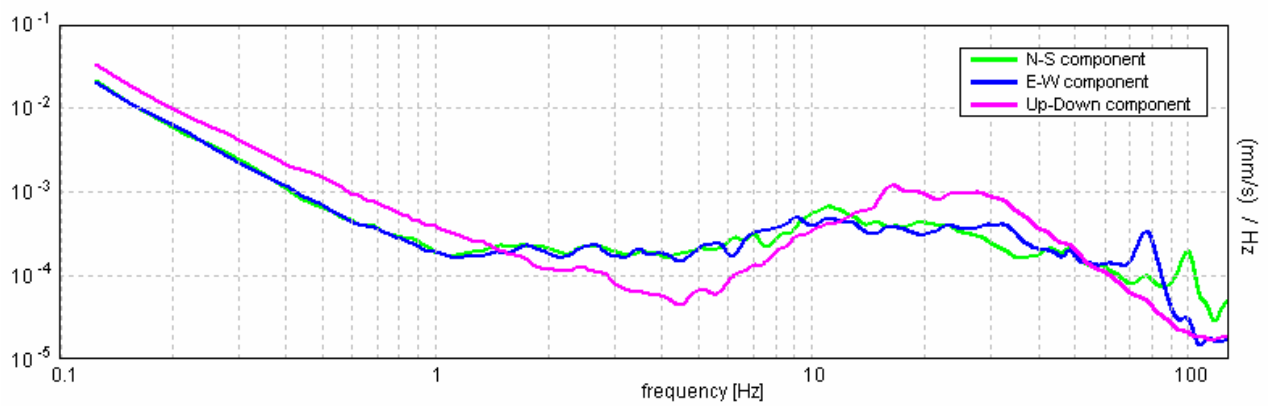
H/V TIME HISTORY



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 4.31 ± 3.61 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$4.31 > 0.50$	OK	
$n_c(f_0) > 200$	$6727.5 > 200$	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 208 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	2.281 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	7.469 Hz	OK	
$A_0 > 2$	$4.32 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.41706 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$1.79857 < 0.21563$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.2037 < 1.58$	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

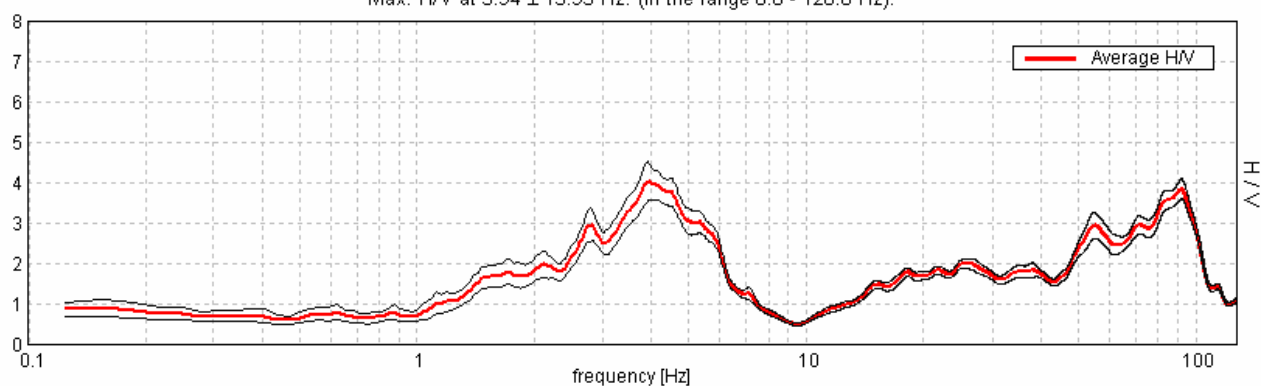
S_BENEDETTO, 28

Start recording: 21/07/09 10:08:00 End recording: 21/07/09 10:34:01
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

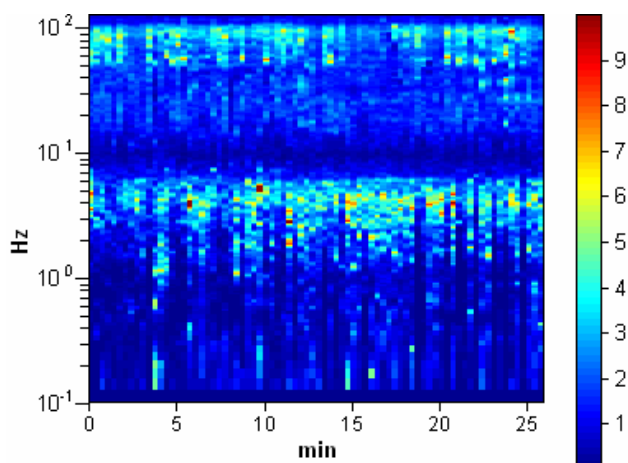
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

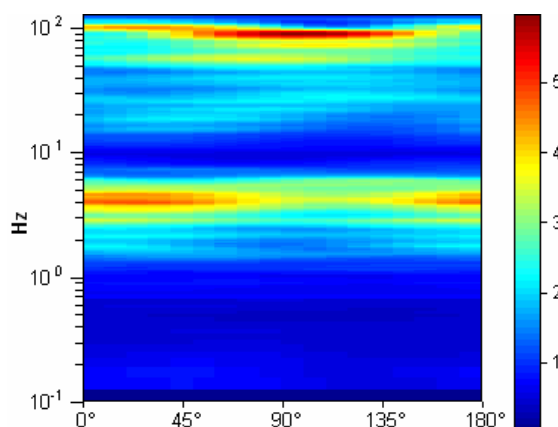
Max. H/V at 3.94 ± 13.95 Hz. (in the range 0.0 - 128.0 Hz).



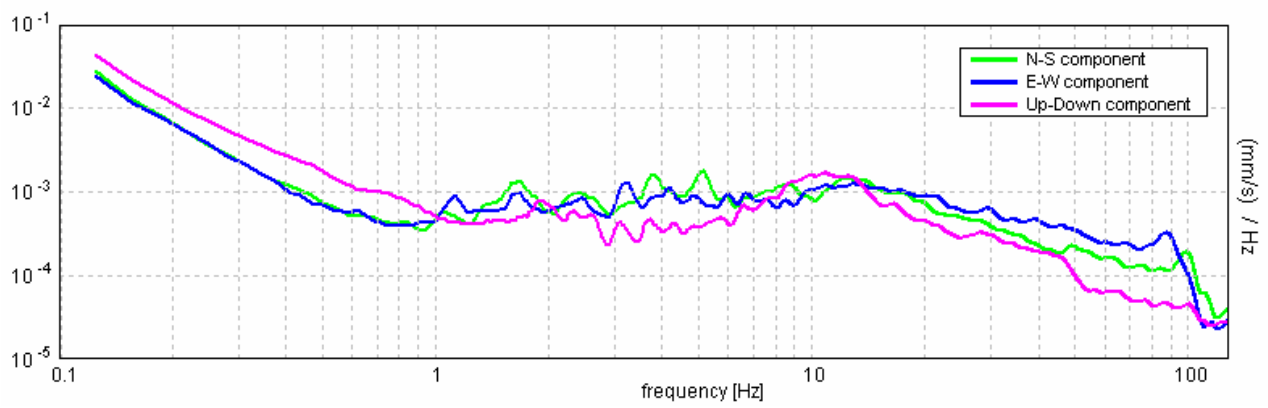
H/V TIME HISTORY



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 3.94 ± 13.95 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$3.94 > 0.50$	OK	
$n_c(f_0) > 200$	$6142.5 > 200$	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 190 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	2.438 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	6.156 Hz	OK	
$A_0 > 2$	$4.04 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 1.76687 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$6.95706 < 0.19688$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.2394 < 1.58$	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

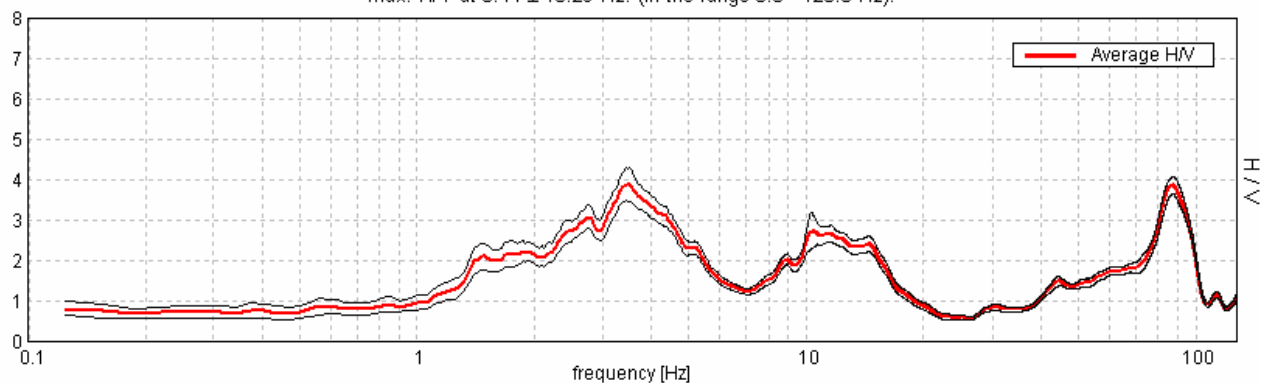
S_ANGELO, 29

Start recording: 21/07/09 11:57:40 End recording: 21/07/09 12:23:41
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

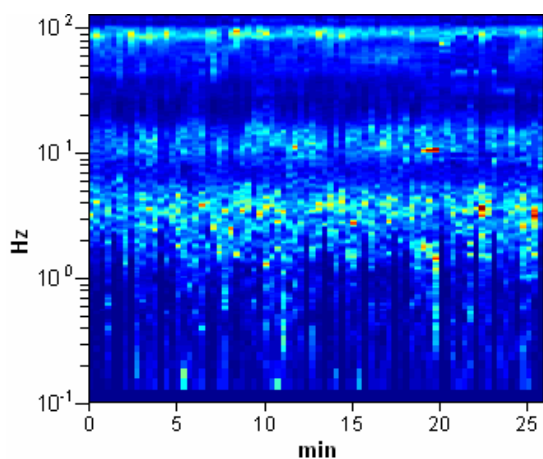
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

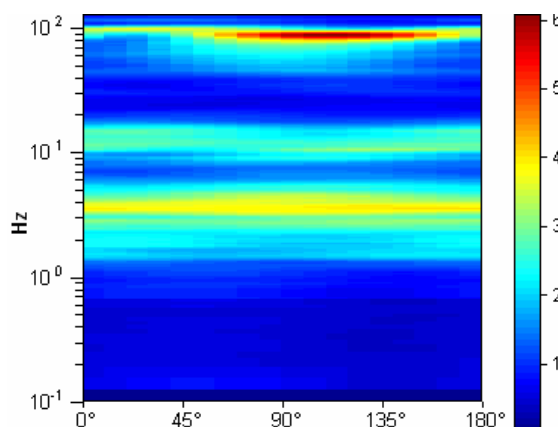
Max. H/V at 3.44 ± 18.29 Hz. (in the range 0.0 - 128.0 Hz).



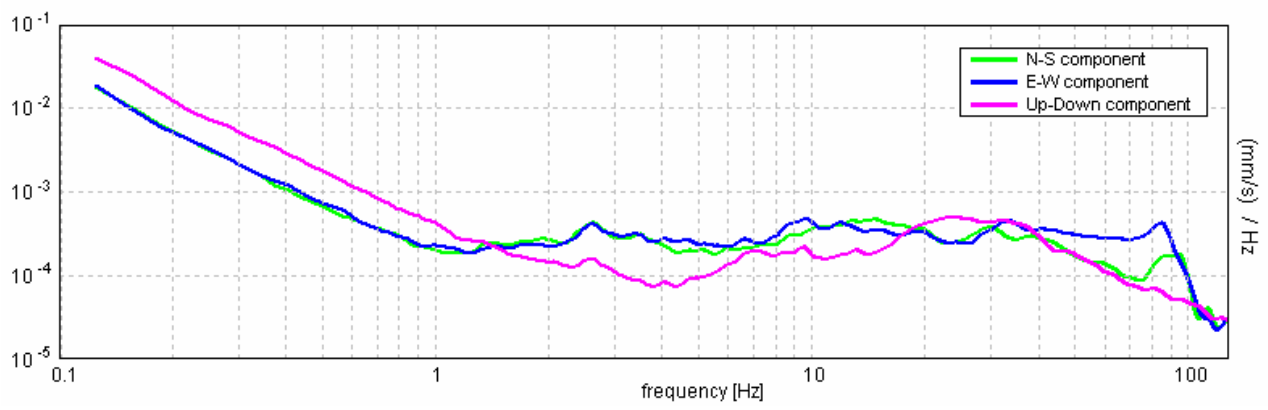
H/V TIME HISTORY



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 3.44 ± 18.29 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$3.44 > 0.50$	OK	
$n_c(f_0) > 200$	$5362.5 > 200$	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 166 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	1.375 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	5.531 Hz	OK	
$A_0 > 2$	$3.90 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 2.65345 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$9.12124 < 0.17188$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.1966 < 1.58$	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

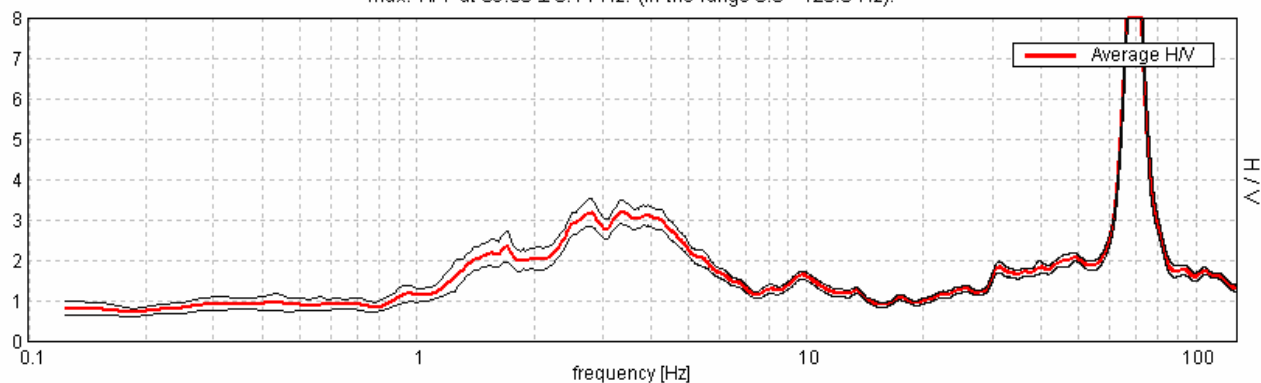
S_ANGELO, 30

Start recording: 21/07/09 11:22:21 End recording: 21/07/09 11:48:22
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

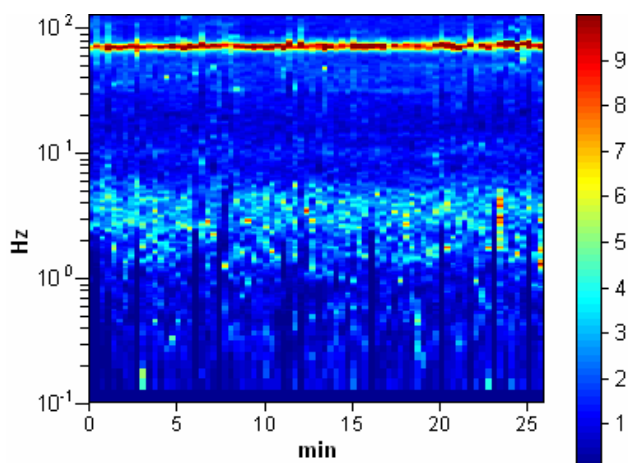
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

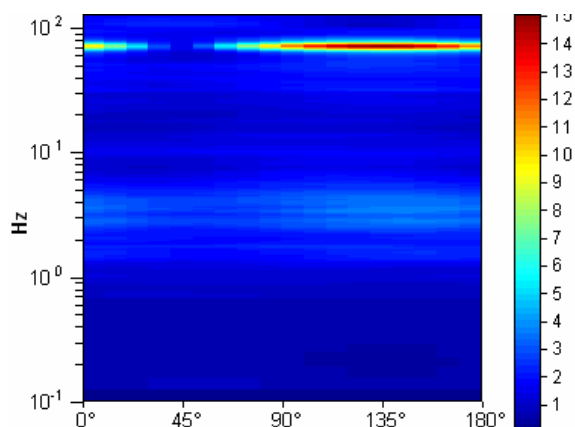
Max. H/V at 69.88 ± 0.14 Hz. (in the range 0.0 - 128.0 Hz).



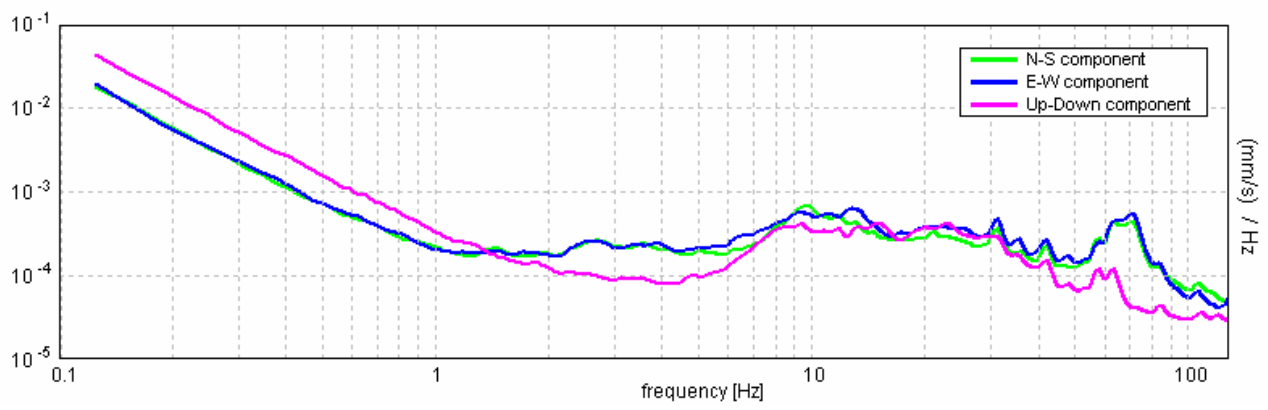
H/V TIME HISTORY



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 69.88 ± 0.14 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	69.88 > 0.50	OK	
$n_c(f_0) > 200$	109005.0 > 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 2979 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	64.469 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	74.969 Hz	OK	
$A_0 > 2$	10.60 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00101 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.07067 < 3.49375$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.2728 < 1.58$	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

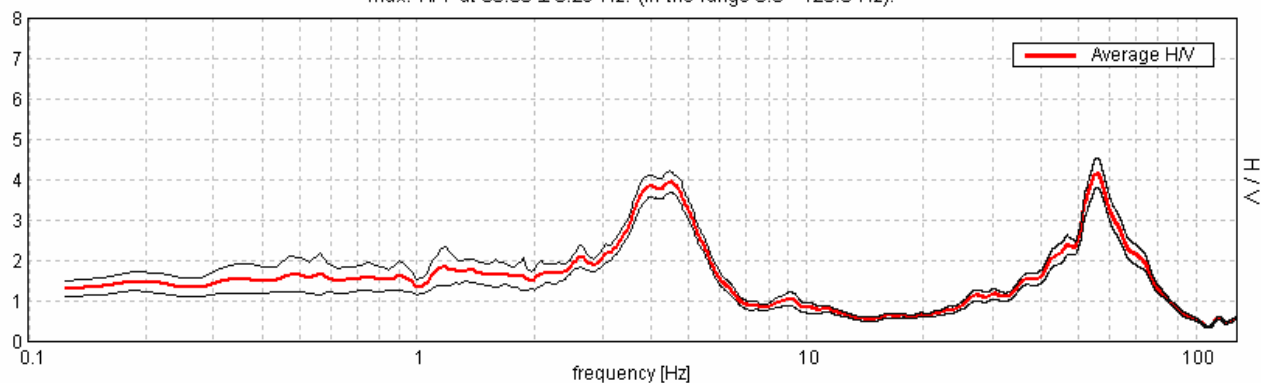
VALLE SINDOLA, 31

Start recording: 21/07/09 15:15:07 End recording: 21/07/09 15:41:08
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

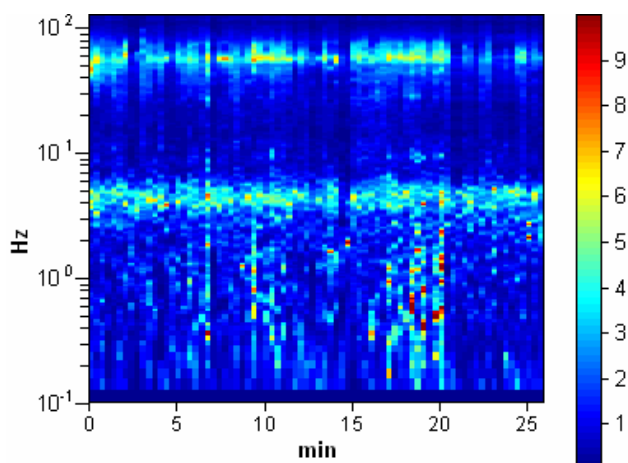
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

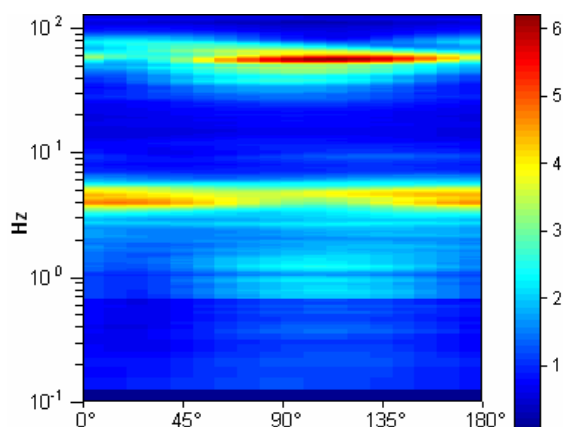
Max. H/V at 55.63 ± 5.29 Hz. (in the range 0.0 - 128.0 Hz).



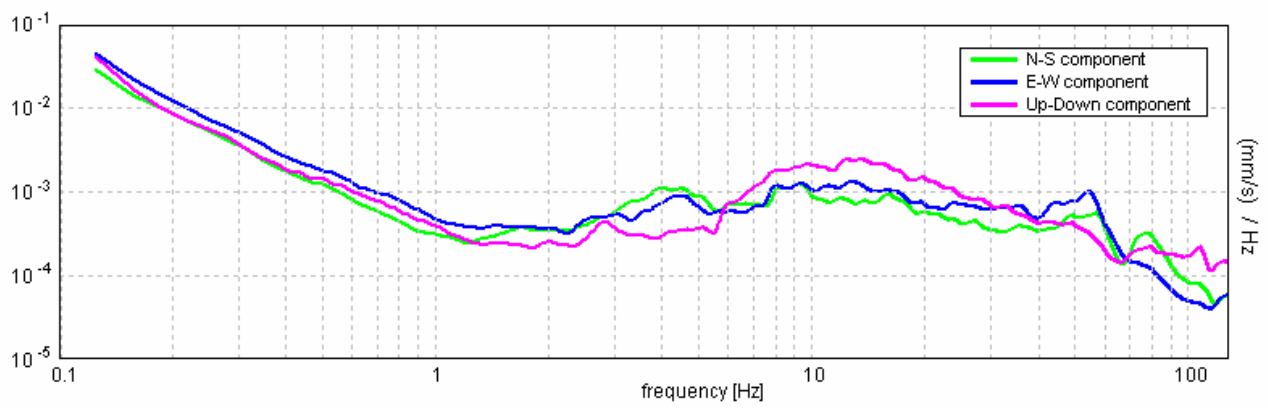
H/V TIME HISTORY



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 55.63 ± 5.29 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	55.63 > 0.50	OK	
$n_c(f_0) > 200$	86775.0 > 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 2671 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	42.844 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	71.906 Hz	OK	
$A_0 > 2$	4.17 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.04739 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	2.63612 < 2.78125	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.1825 < 1.58	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

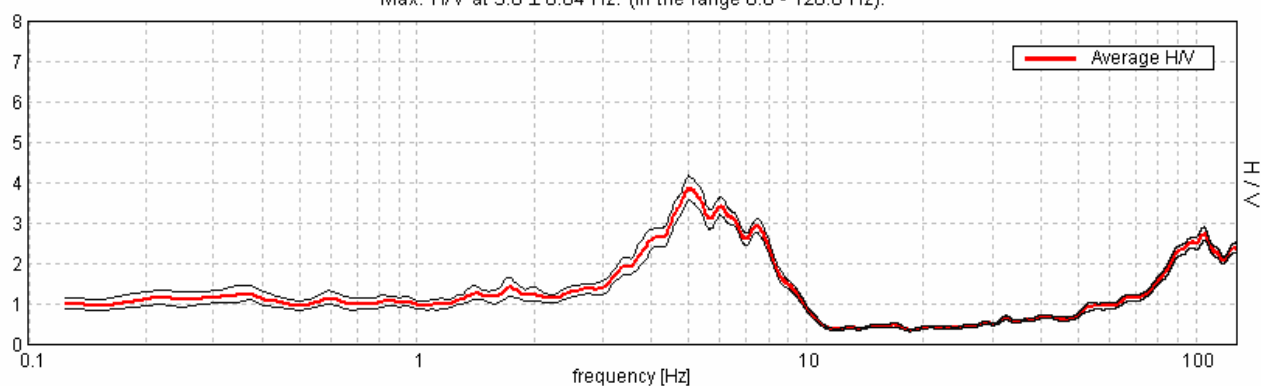
VALLE SINDOLA, 32

Start recording: 21/07/09 16:02:18 End recording: 21/07/09 16:28:18
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

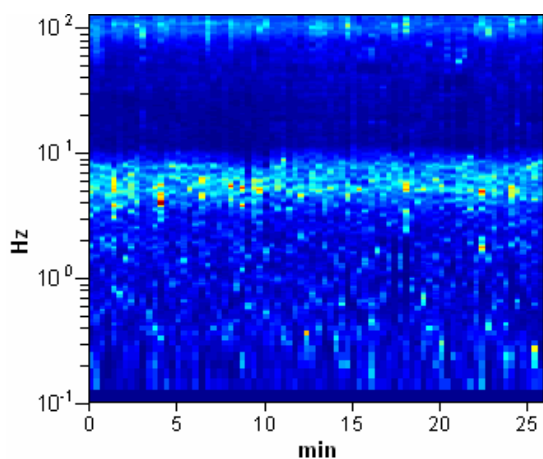
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

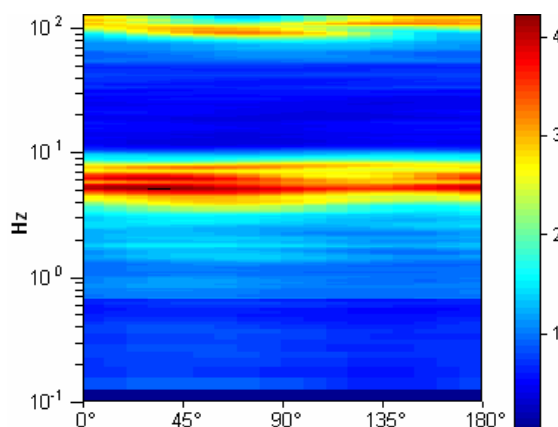
Max. H/V at 5.0 ± 0.04 Hz. (in the range 0.0 - 128.0 Hz).



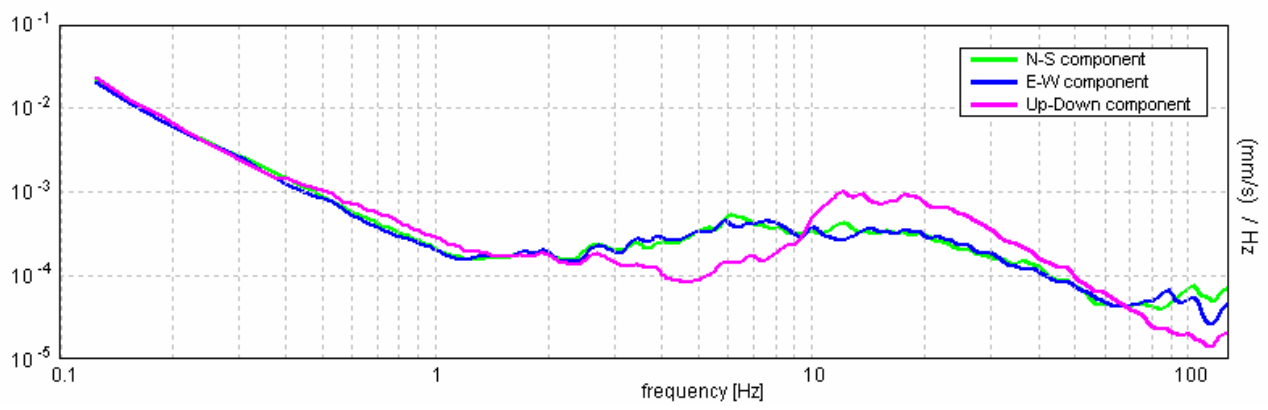
H/V TIME HISTORY



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 5.0 ± 0.04 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$5.00 > 0.50$	OK	
$n_c(f_0) > 200$	$7800.0 > 200$	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 241 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	3.531 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	8.344 Hz	OK	
$A_0 > 2$	$3.89 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00439 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.02197 < 0.25$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1505 < 1.58$	OK	

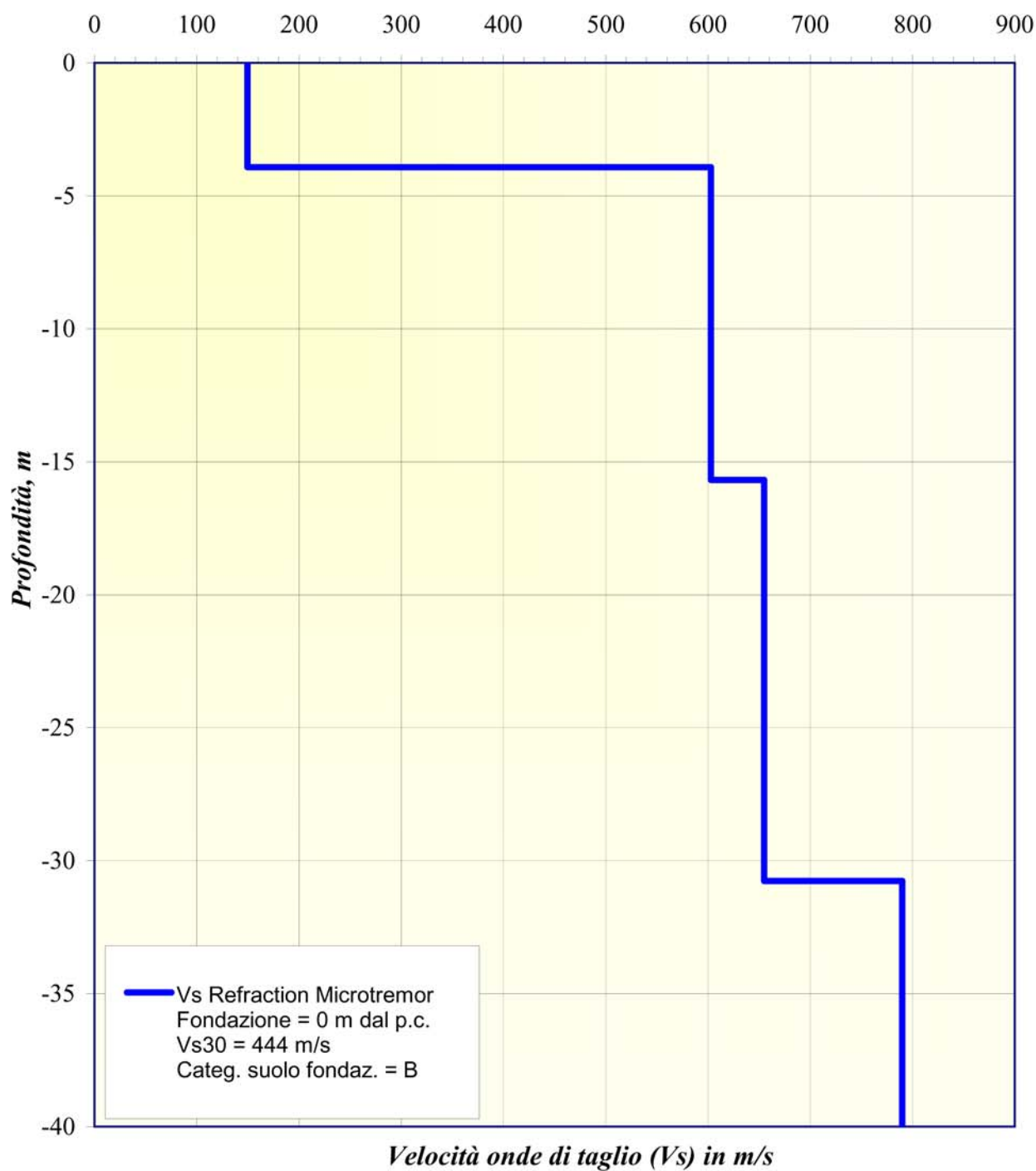
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak 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

S. Benedetto 26

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



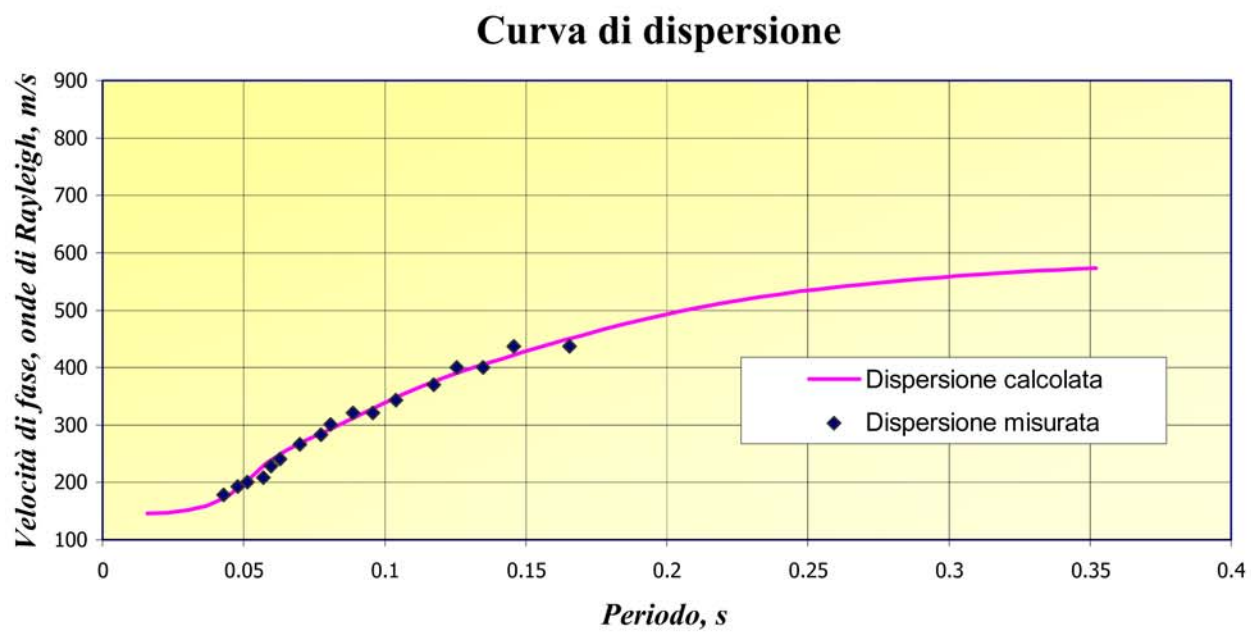
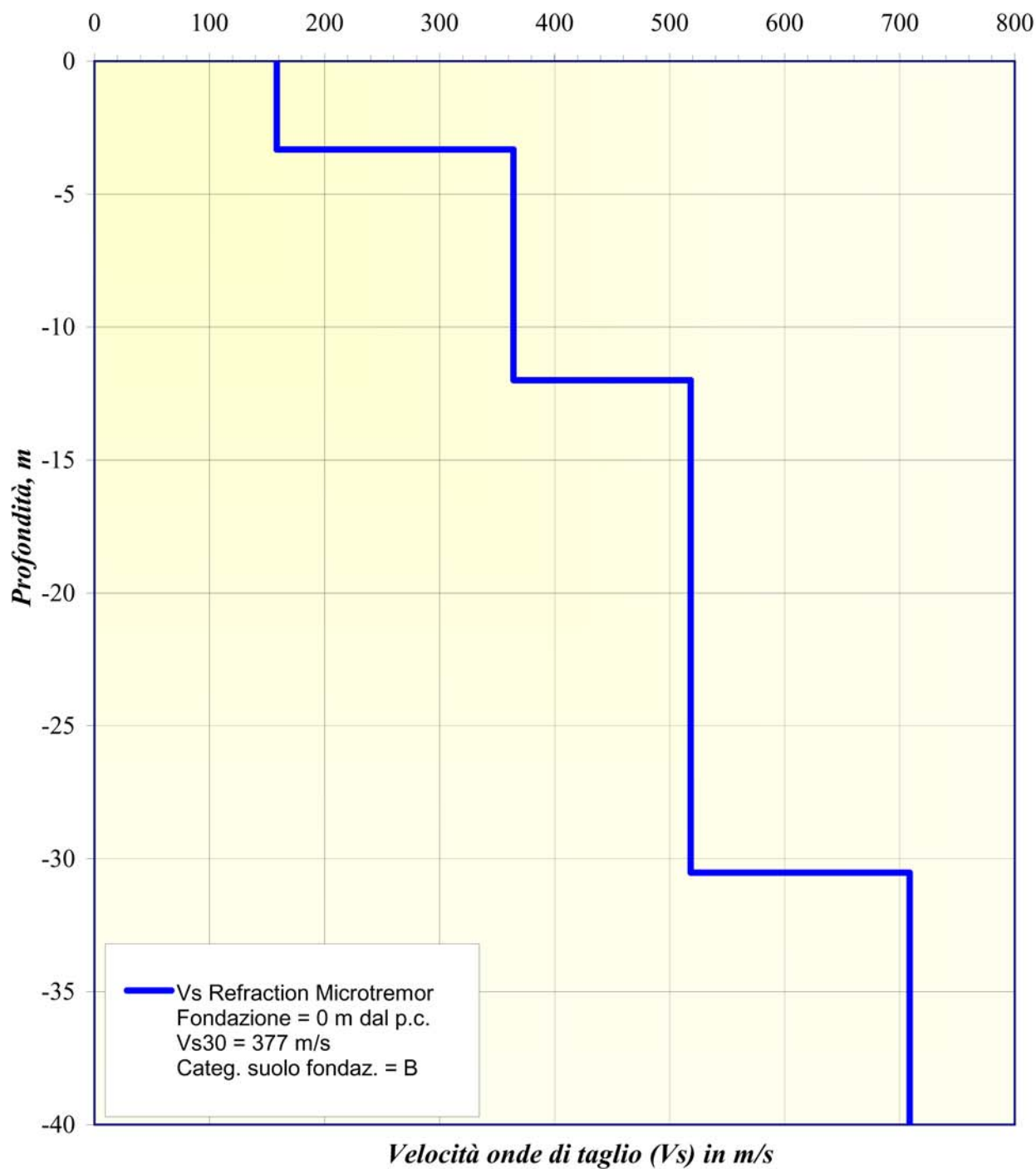


grafico slowness/frequenza

S. Benedetto 28

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

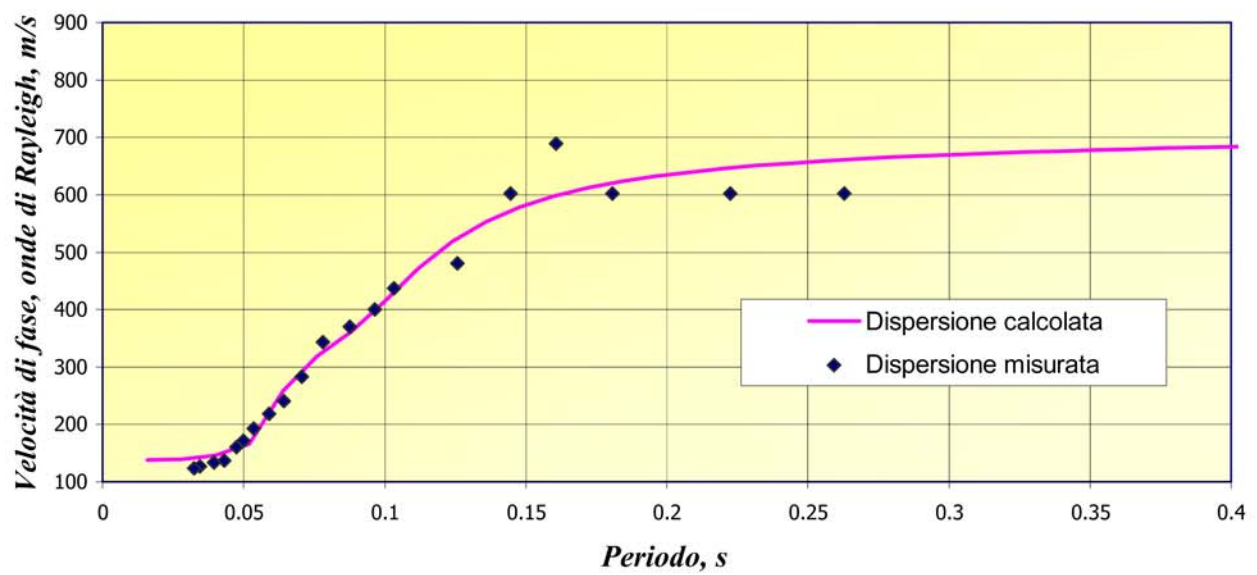
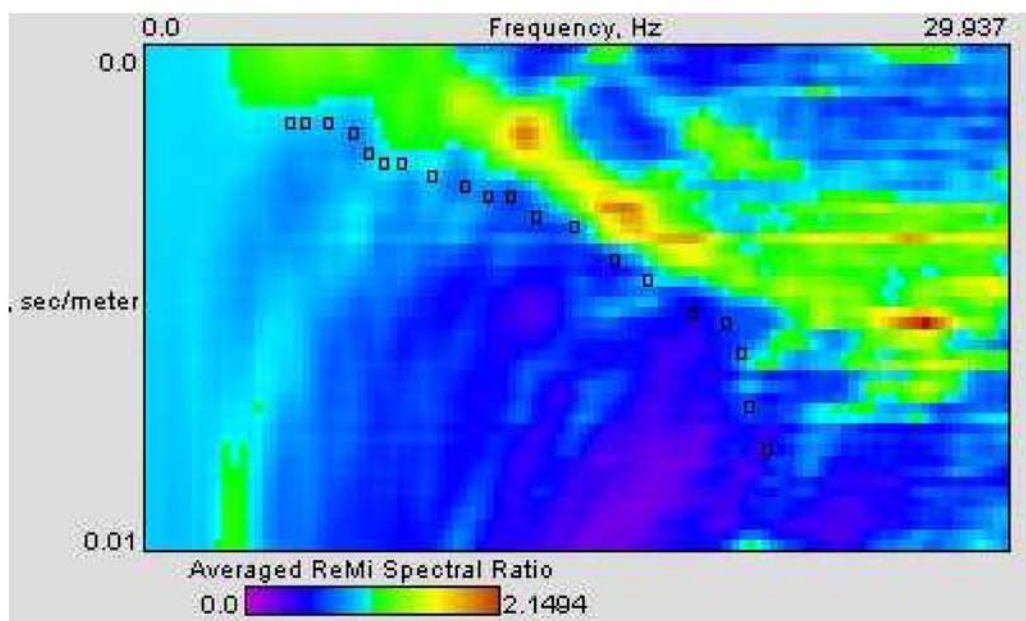


grafico slowness/frequenza



**REGIONE
TOSCANA**



**Direzione Generale delle Politiche
Territoriali e Ambientali
Coordinamento Regionale Prevenzione Sismica**



**MICROZONAZIONE SISMICA
DELLA CONCA AQUILANA
(terremoto 06-04-2009)**

Relazione tecnica finale di sintesi - Macroarea 9

**SAN FELICE D'OCRE - PROVE MASW E
SISMICA PASSIVA (REMI)**

	indagine ReMi		indagine H/V		
nome	S Felice 1		S. Felice 1		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	228	2.9	strumento effettuata componente orizzontale E-W	difettoso; utilizzando solo la	valutazione
2° livello	460	15.9			
3° livello	769	41			
4° livello	891				
5° livello					
6° livello					
Vs 30	505		3.6	556	38.6
			Classe misura		C

	indagine ReMi		indagine H/V		
nome	S Felice 2		S. Felice 2		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	171	2.3			
2° livello	289	19.4			
3° livello	489	32.8			
4° livello	667				
5° livello					
6° livello					
Vs 30	319		3	330	27.5
			Classe misura		A

	indagine ReMi		indagine H/V		
nome	S Felice 3		S. Felice 3		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	172	2.4			
2° livello	293	9.3			
3° livello	436	28.3			
4° livello	610				
5° livello					
6° livello					
Vs 30	359				
			Classe misura		C

	indagine ReMi		indagine H/V		
nome	S Felice 4		S. Felice 4		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	69	0.5	strumento effettuata componente orizzontale N-S	difettoso; utilizzando solo la	valutazione
2° livello	323	14.5			
3° livello	451	25.2			
4° livello	850				
5° livello					
6° livello					
Vs 30	377		3.6	340	23.6
			Classe misura		C

	indagine ReMi		indagine H/V		
nome	S Felice 5		S. Felice 5		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	218	2.1			
2° livello	1231	41.3			
3° livello	1009	80			
4° livello	1545				
5° livello					
6° livello					
Vs 30	925				
			Classe misura		C

|

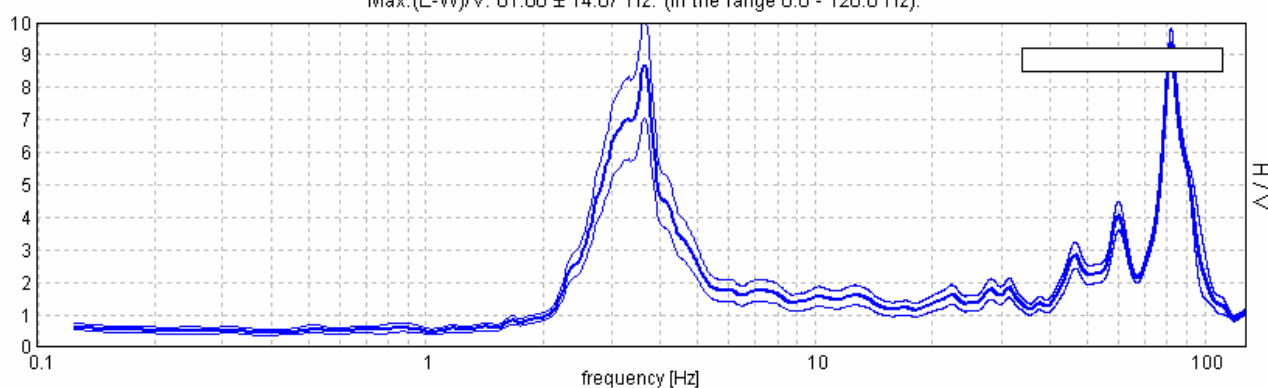
SAN FELICE D'OCRE, 8

Start recording: 02/07/09 08:10:59 End recording: 02/07/09 08:39:00
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

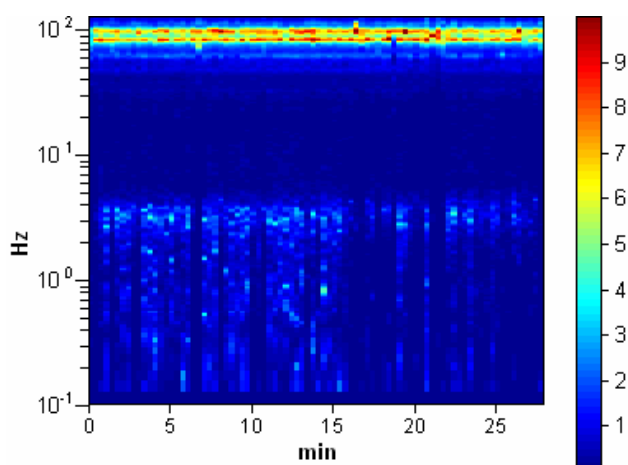
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

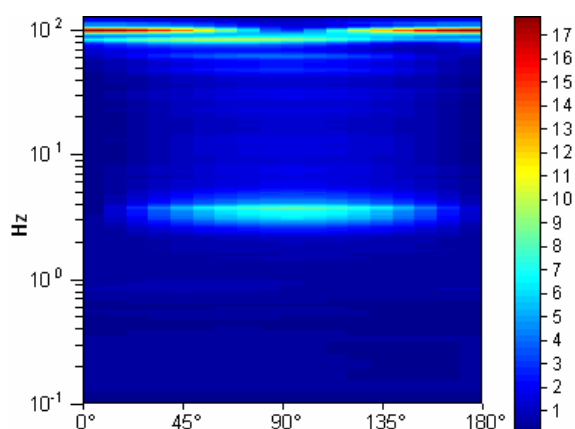
Max.(E-W)/V: 81.88 ± 14.07 Hz. (In the range 0.0 - 128.0 Hz).



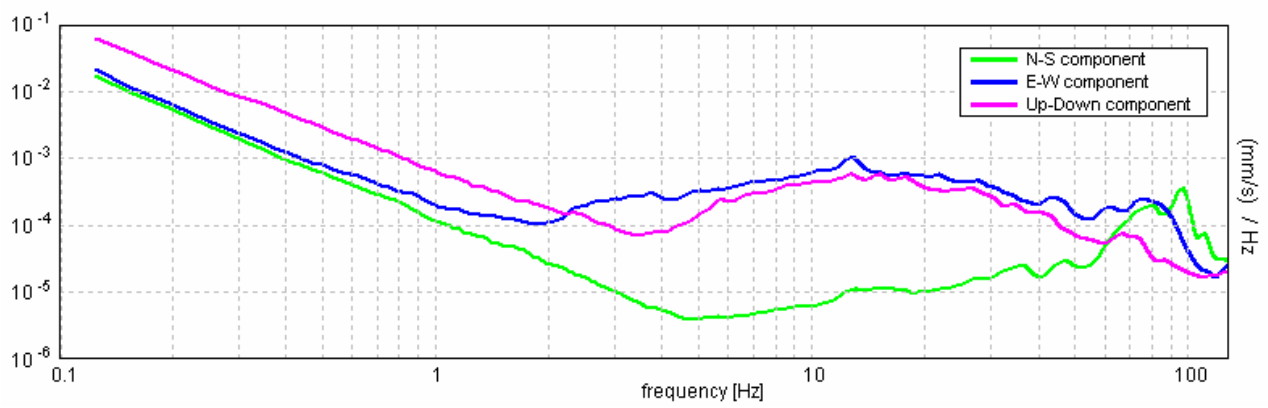
H/V TIME HISTORY



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 81.66 ± 0.37 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$81.66 > 0.50$	OK	
$n_c(f_0) > 200$	$137182.5 > 200$	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 2790 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	76.406 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	102.063 Hz	OK	
$A_0 > 2$	$7.85 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00225 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.18357 < 4.08281$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1535 < 1.58$	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

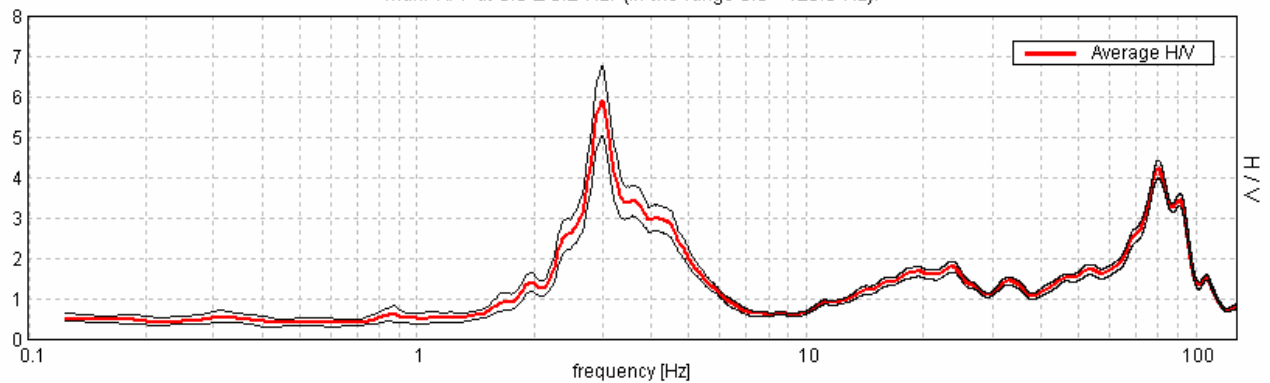
SAN FELICE D'OCRE, 9

Start recording: 02/07/09 08:46:45 End recording: 02/07/09 09:14:46
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

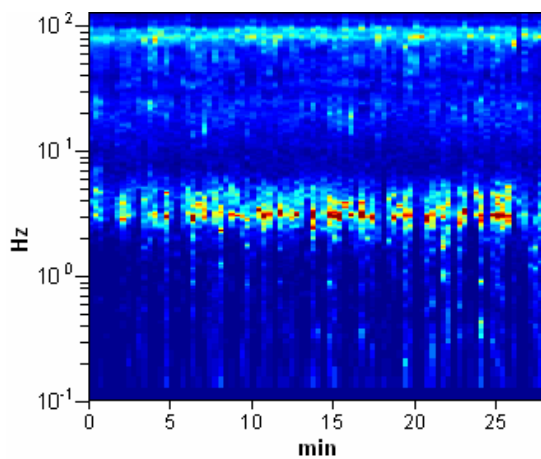
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

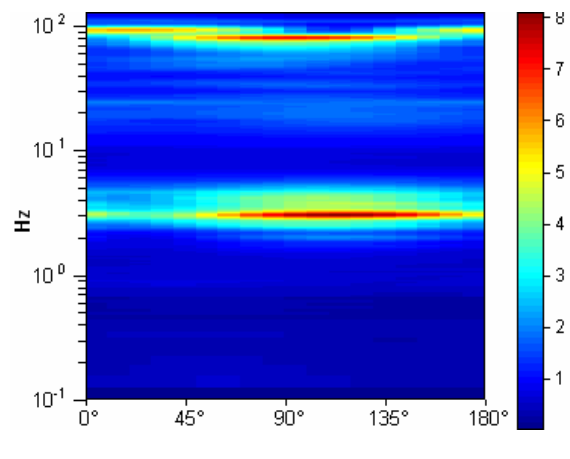
Max. H/V at 3.0 ± 8.2 Hz. (In the range 0.0 - 128.0 Hz).



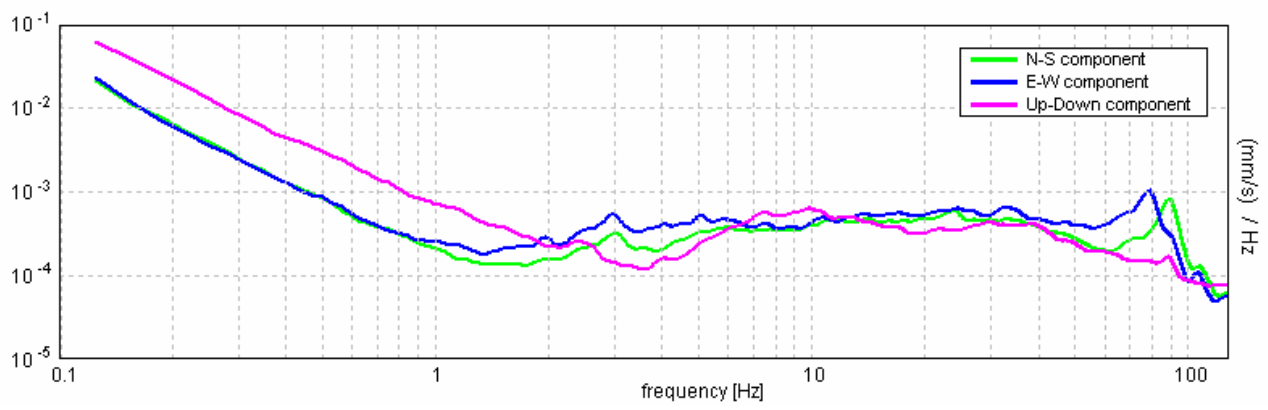
H/V TIME HISTORY



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 3.0 ± 8.2 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$3.00 > 0.50$	OK	
$n_c(f_0) > 200$	$5040.0 > 200$	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 145 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	2.594 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	4.344 Hz	OK	
$A_0 > 2$	$5.90 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 1.36658 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$4.09974 < 0.15$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.4268 < 1.58$	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

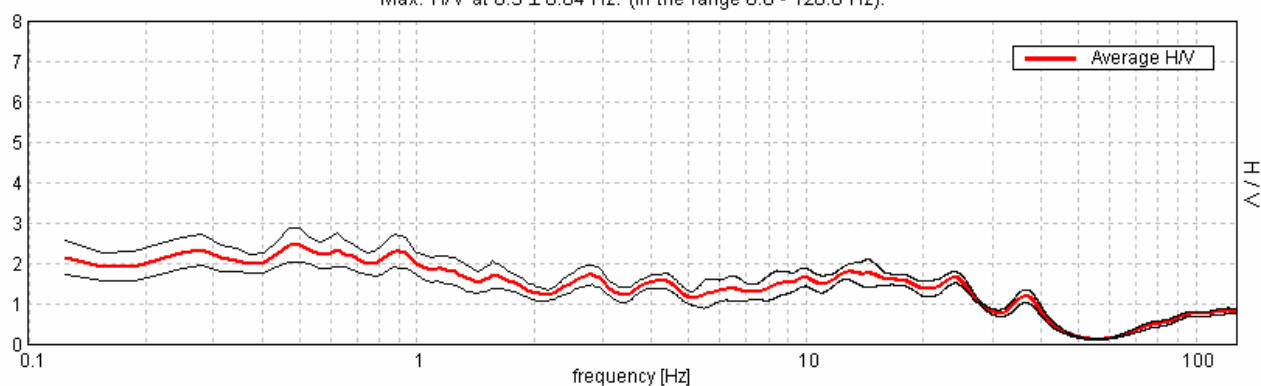
SAN FELICE D'OCRE, 10

Start recording: 02/07/09 09:21:31 End recording: 02/07/09 09:49:32
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

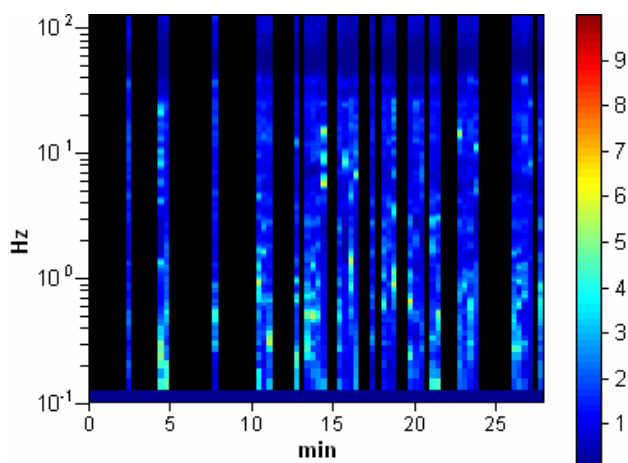
Trace length: 0h28'00". Analyzed 40% trace (manual window selection)
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 10%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

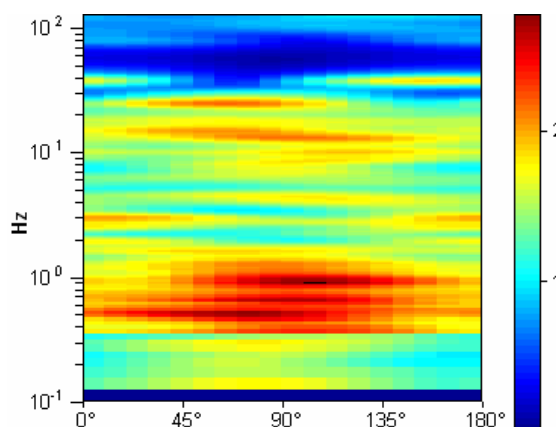
Max. H/V at 0.5 ± 0.04 Hz. (in the range 0.0 - 128.0 Hz).



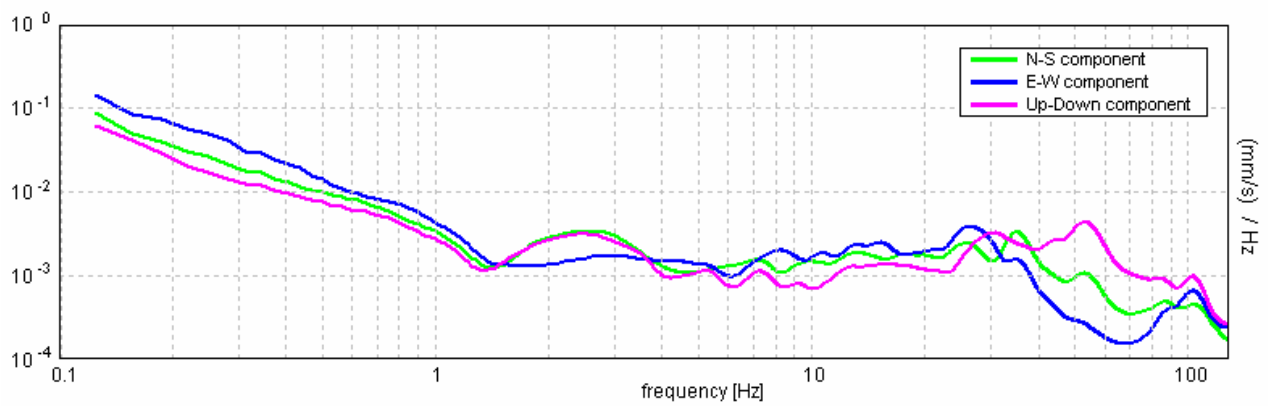
H/V TIME HISTORY



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 0.5 ± 0.04 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$0.50 > 0.50$		NO
$n_c(f_0) > 200$	$340.0 > 200$	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 25 times	OK	

Criteria for a clear HVSR 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
$A_0 > 2$	$2.47 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.03459 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.01729 < 0.075$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.2057 < 2.0$	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

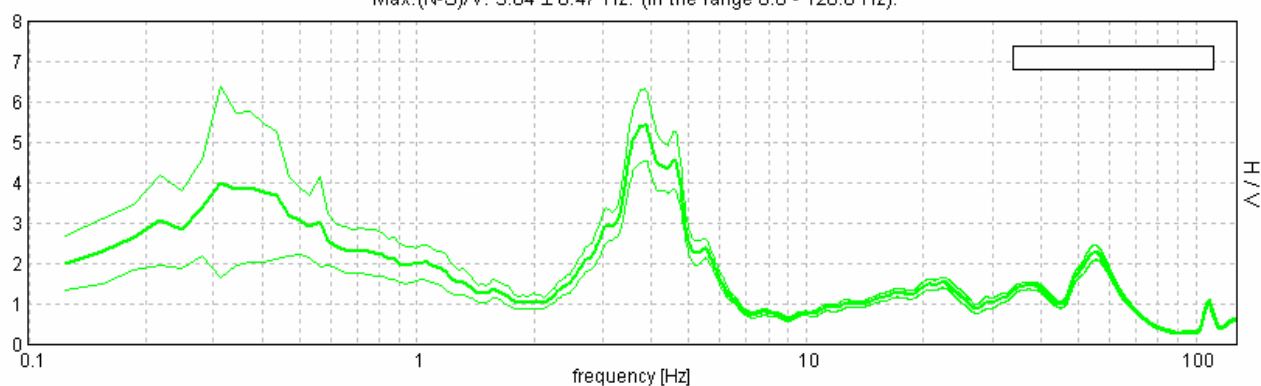
SAN FELICE D'OCRE, 11

Start recording: 02/07/09 10:38:57 End recording: 02/07/09 11:06:58
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

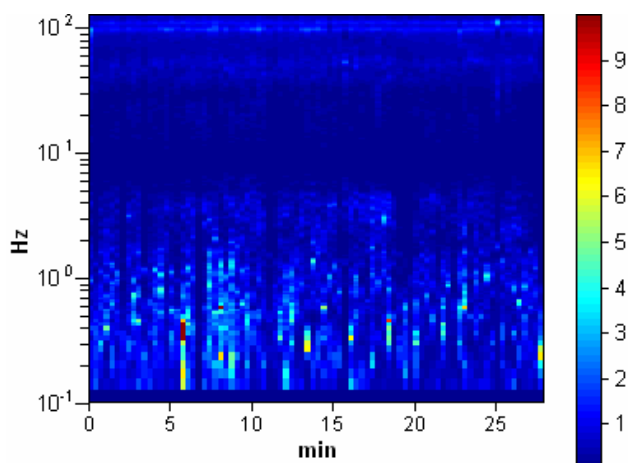
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

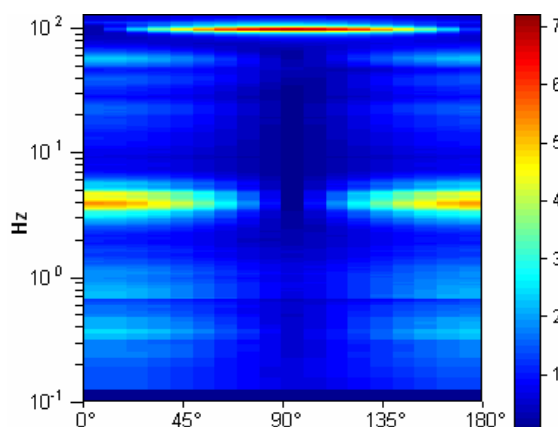
Max.(N-S)/V: 3.84 ± 0.47 Hz. (In the range 0.0 - 128.0 Hz).



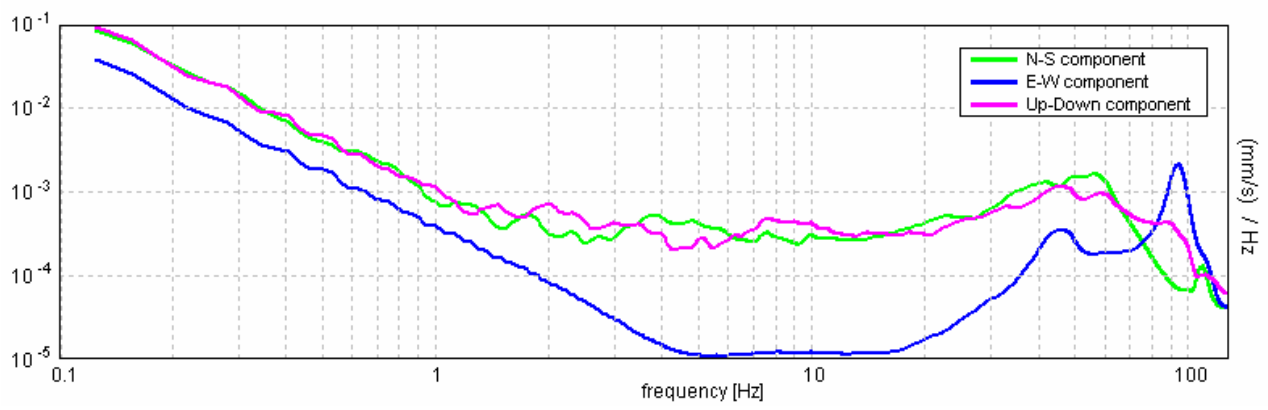
H/V TIME HISTORY



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 0.31 ± 4.5 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$0.31 > 0.50$		NO
$n_c(f_0) > 200$	$525.0 > 200$	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 16 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	0.094 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$			NO
$A_0 > 2$	$1.56 > 2$		NO
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 7.19054 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$2.24704 < 0.0625$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.1845 < 2.5$	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

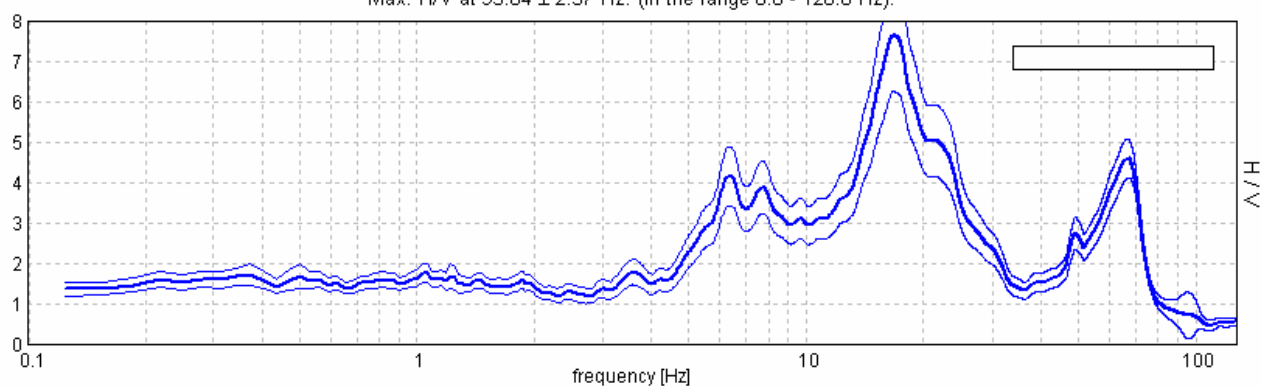
SAN FELICE D'OCRE, 12

Start recording: 02/07/09 11:14:01 End recording: 02/07/09 11:42:02
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

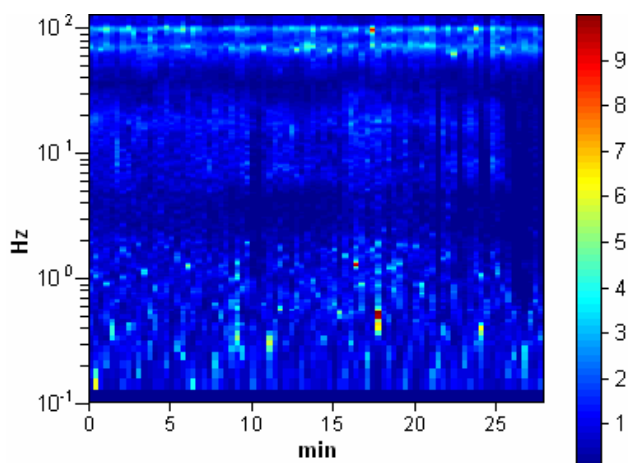
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

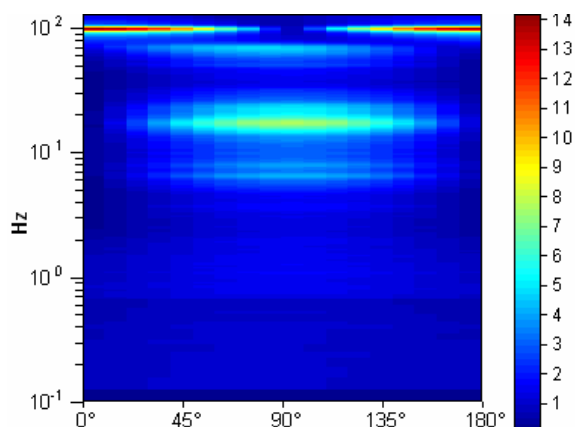
Max. H/V at 95.84 ± 2.37 Hz. (in the range 0.0 - 128.0 Hz).



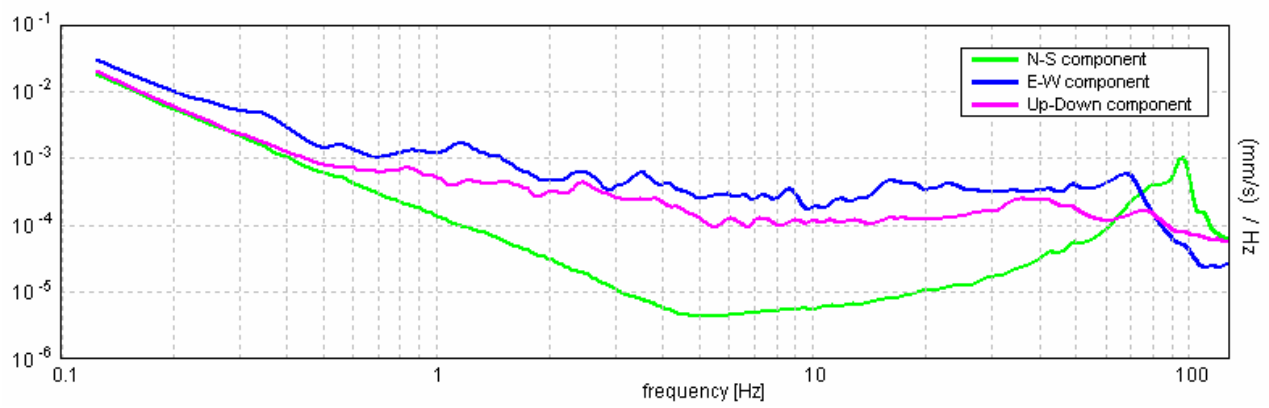
H/V TIME HISTORY



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 95.84 ± 2.37 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	95.84 > 0.50	OK	
$n_c(f_0) > 200$	161017.5 > 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 2564 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	58.844 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	102.438 Hz	OK	
$A_0 > 2$	3.16 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01238 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	1.18646 < 4.79219	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.1079 < 1.58	OK	

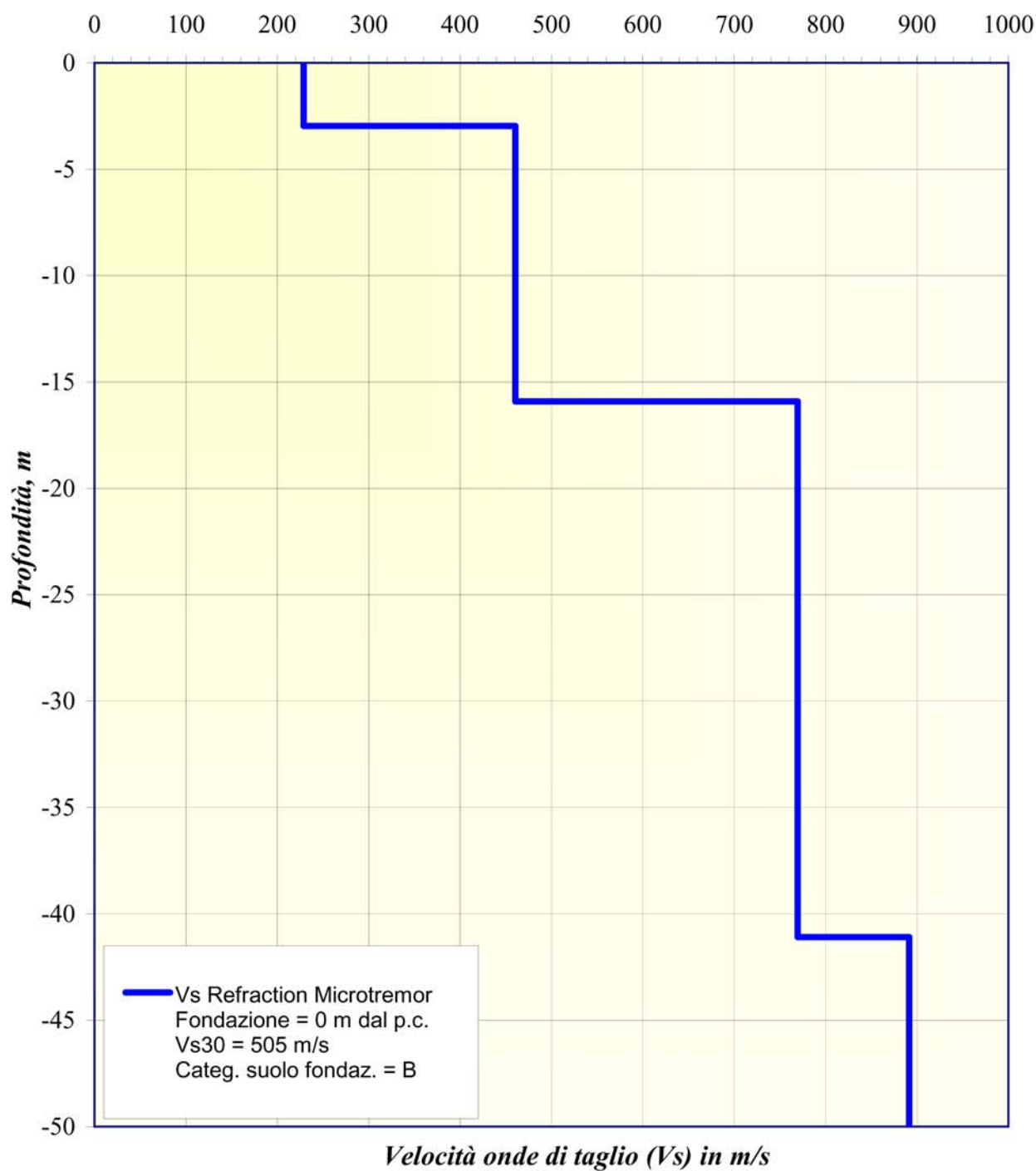
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak 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

S. Felice 8

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

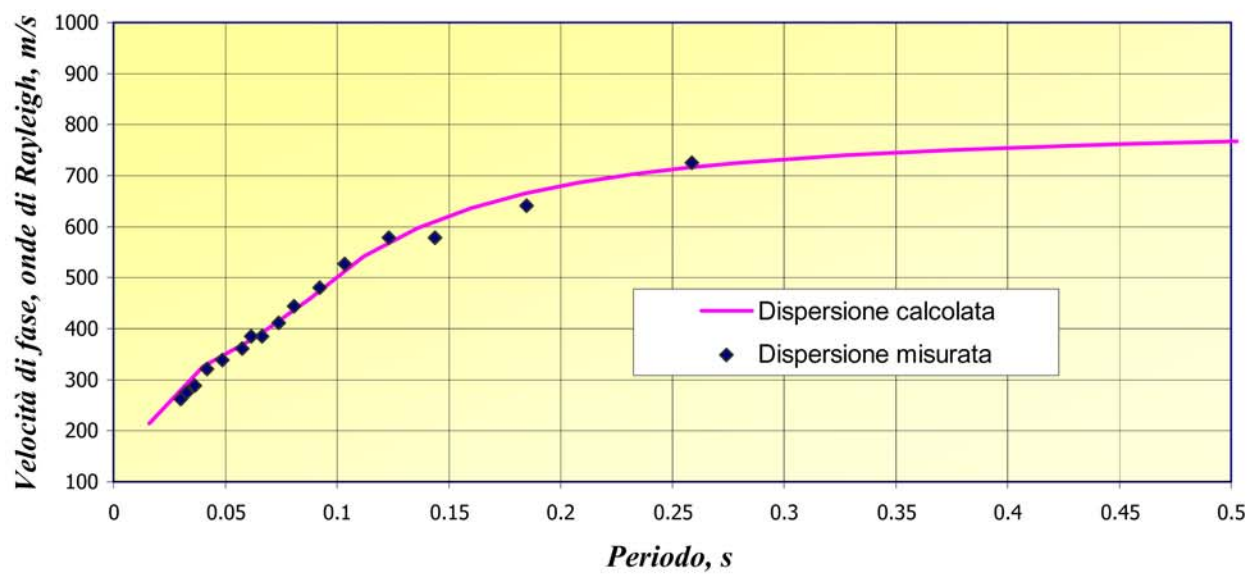
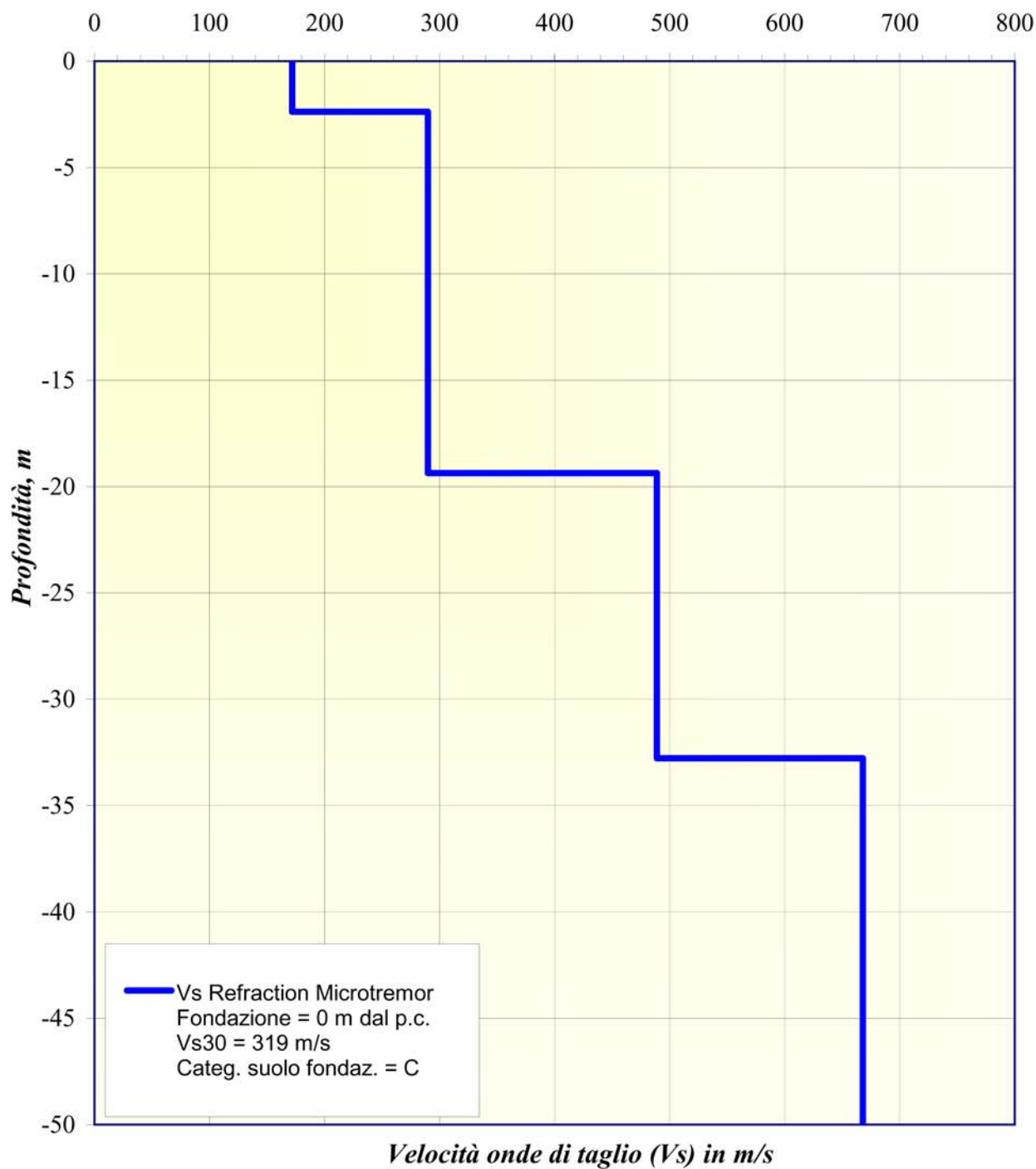


grafico slowness/frequenza

S. Felice 9

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

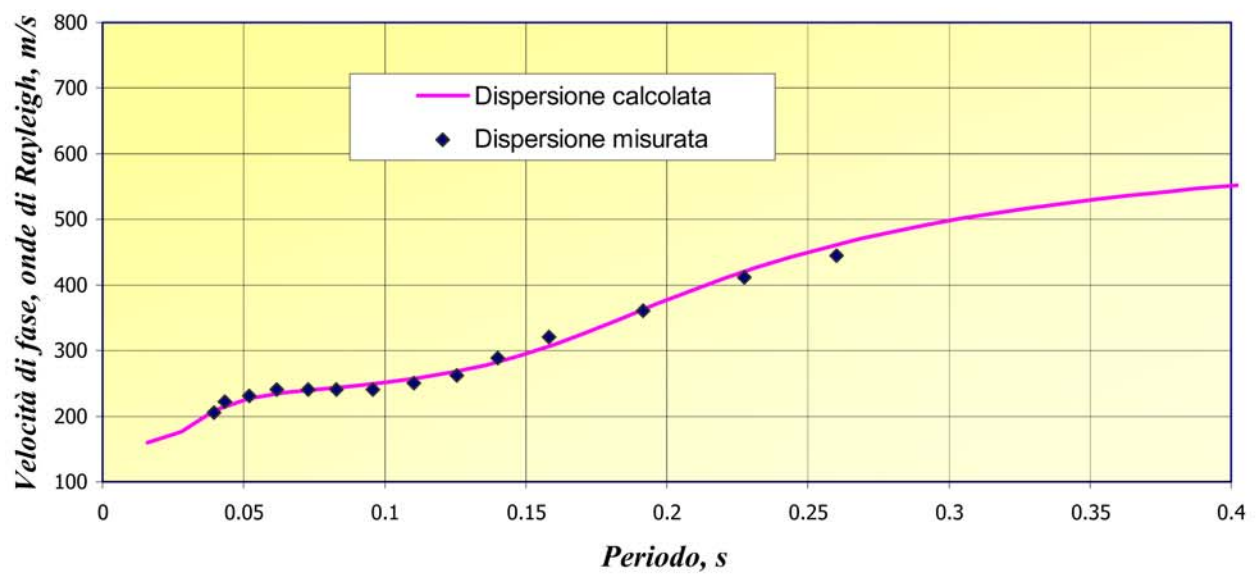
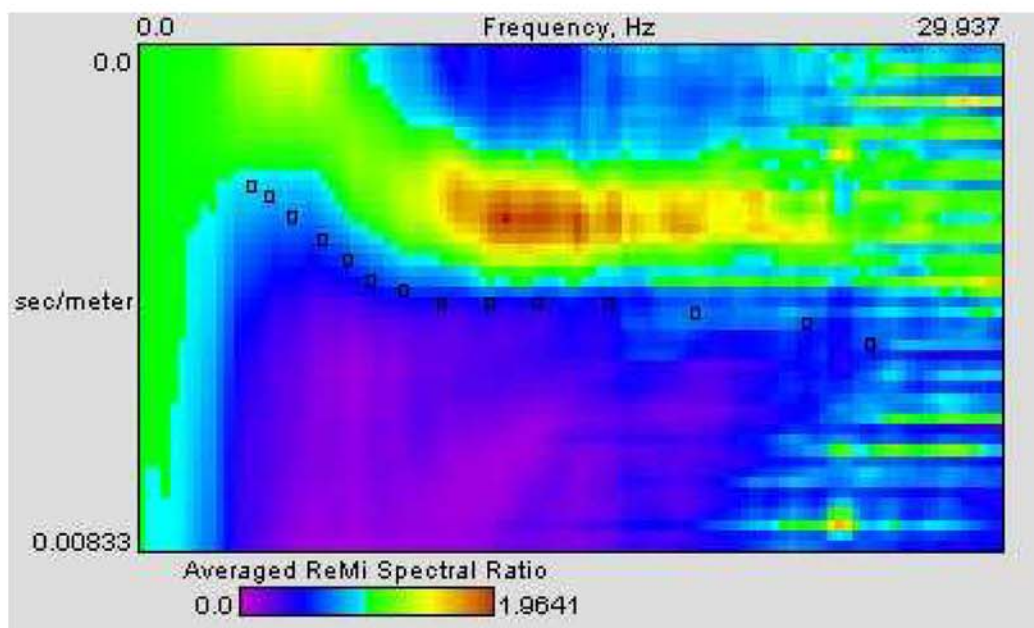
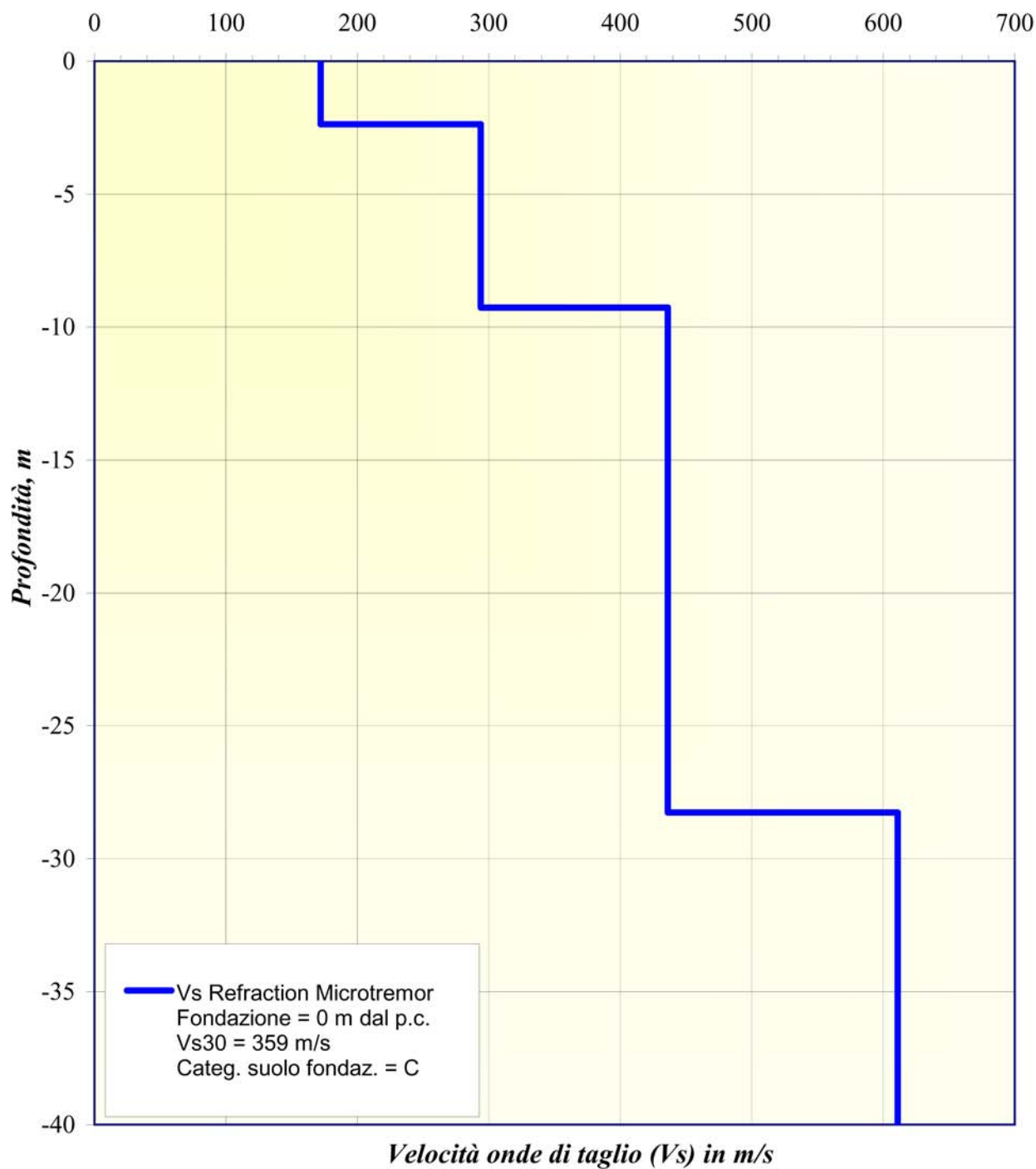


grafico slowness/frequenza



S. Felice 10

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

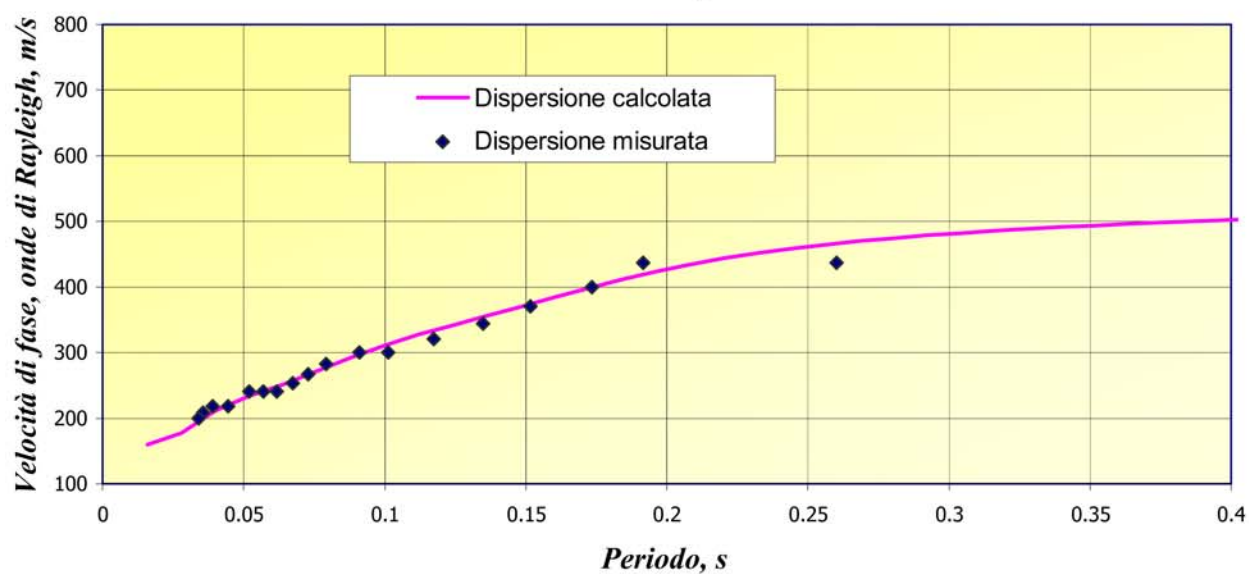
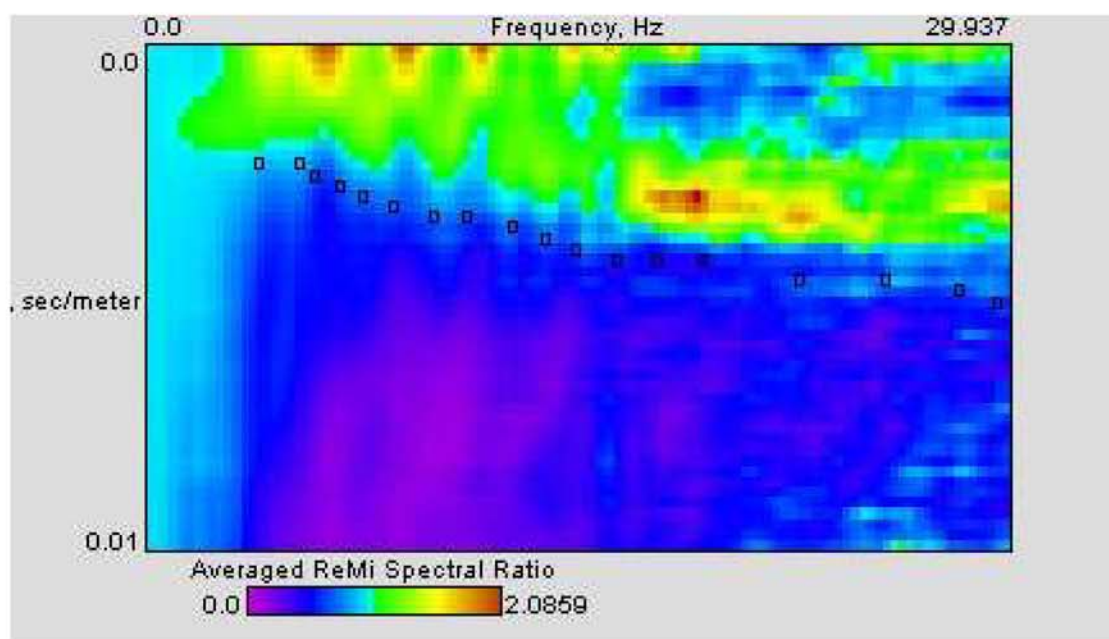
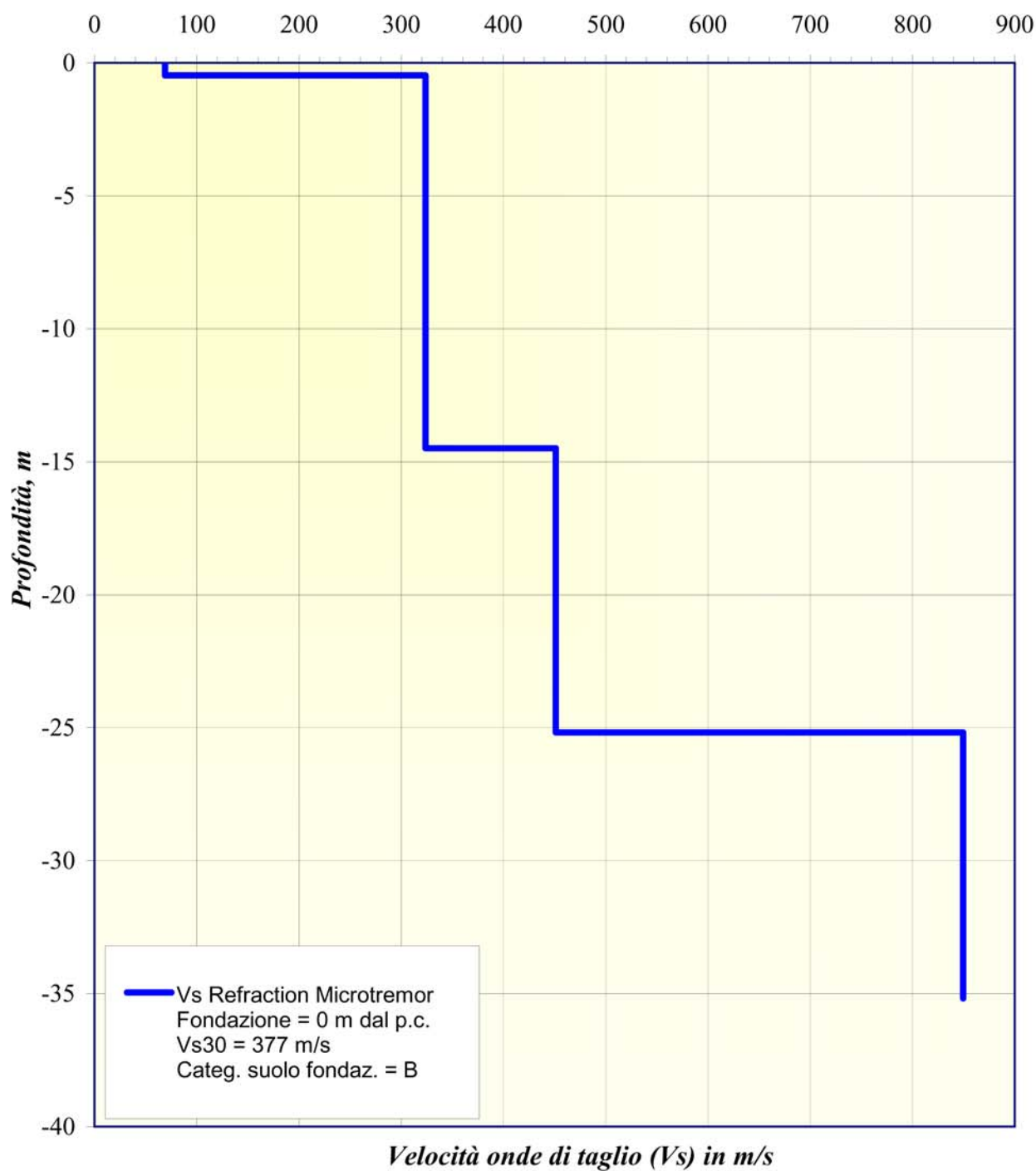


grafico slowness/frequenza



S. Felice 11

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



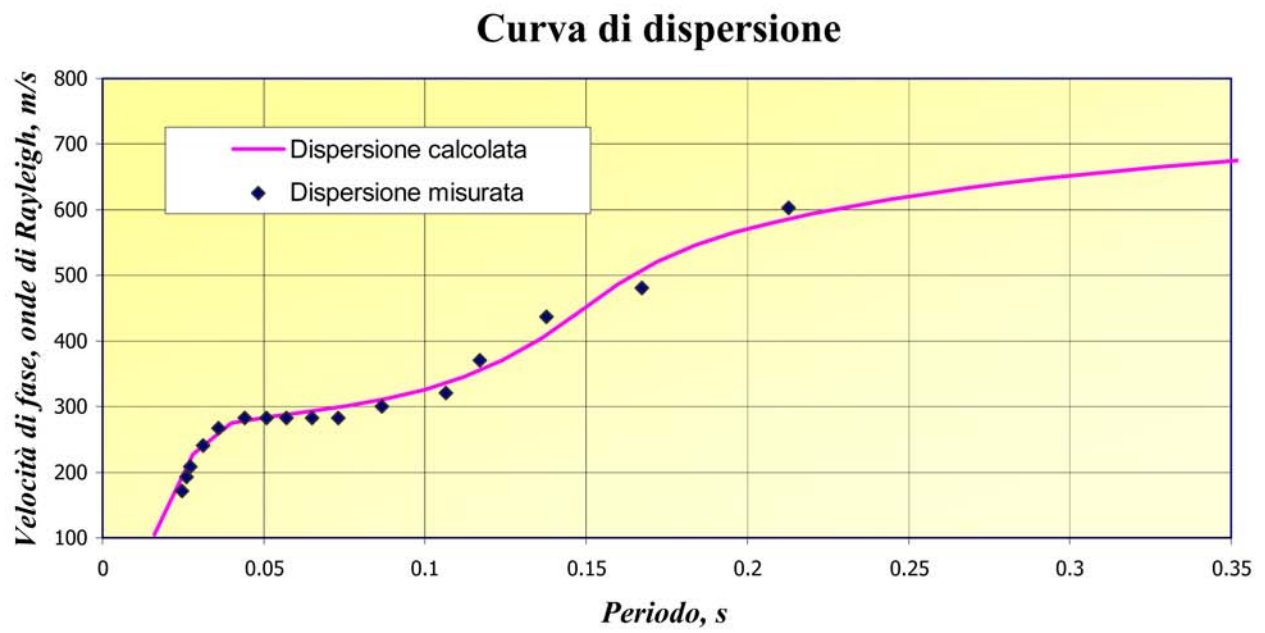
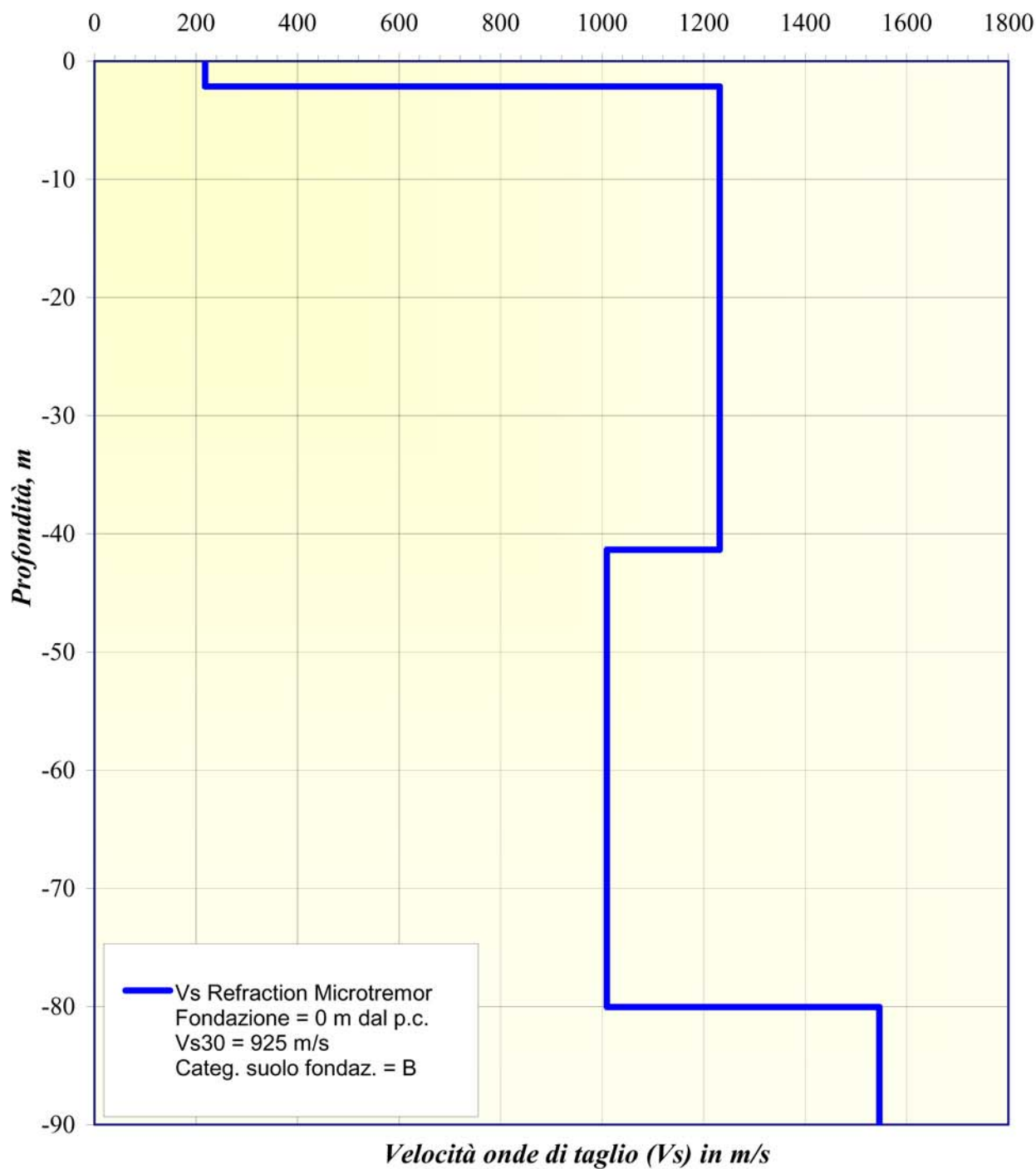


grafico slowness/frequenza

S. Felice 12

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

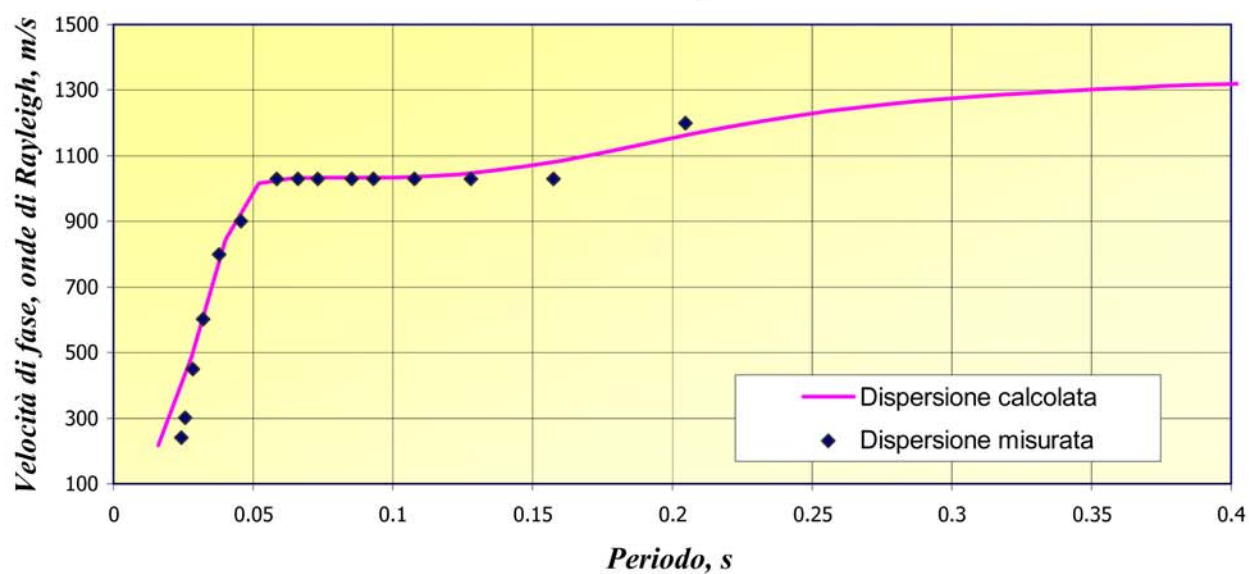
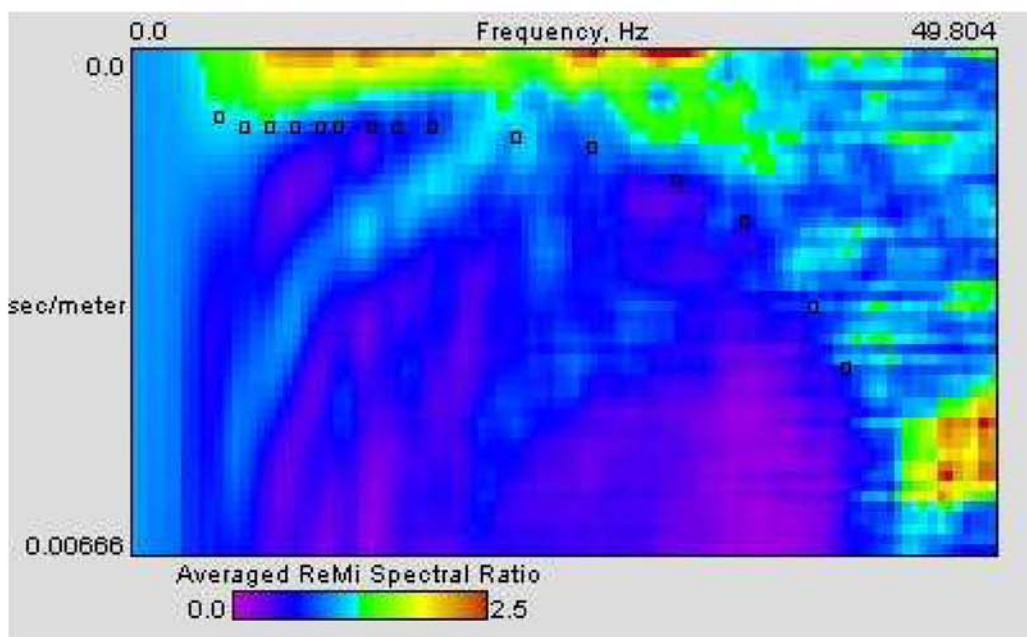
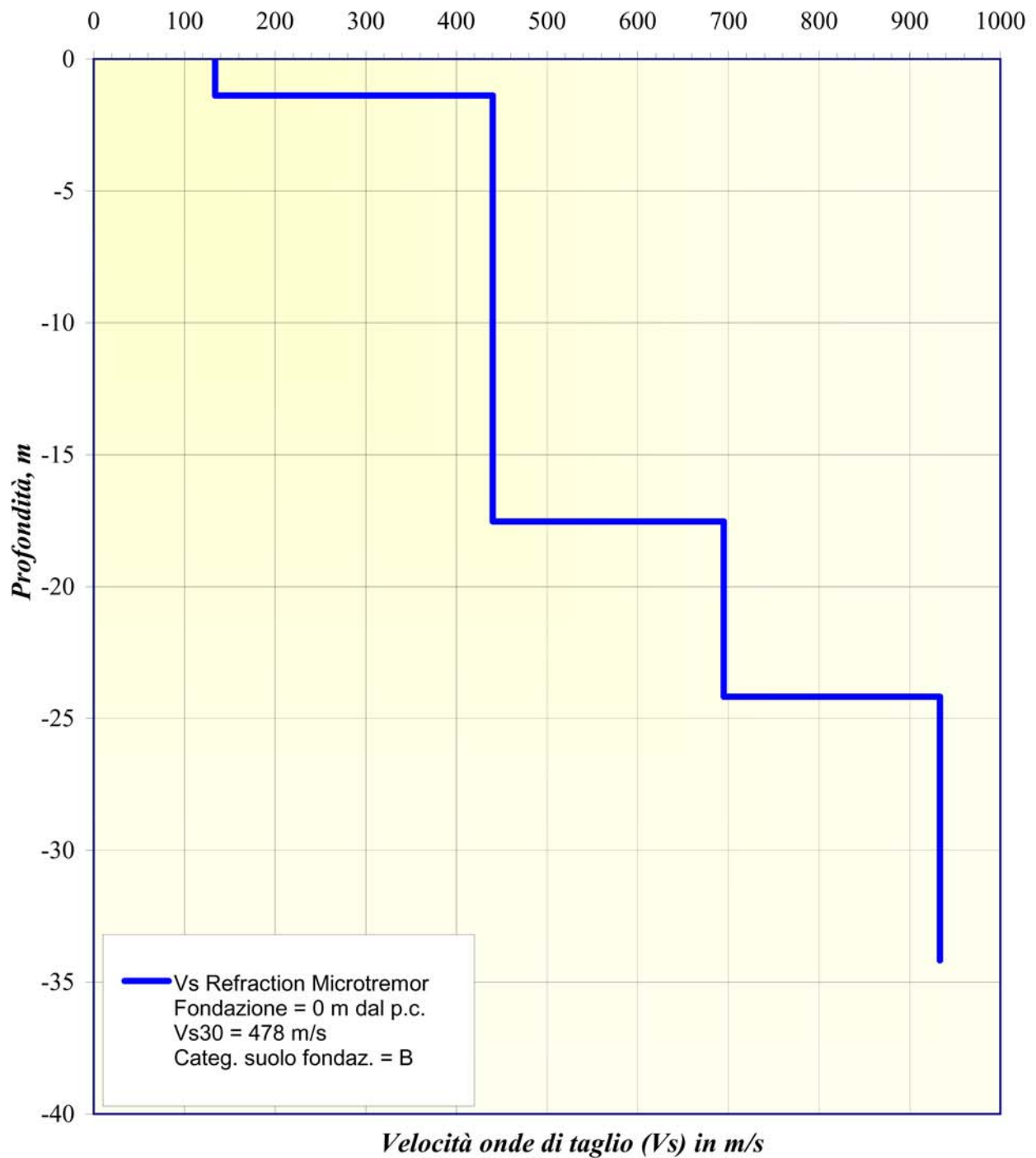


grafico slowness/frequenza



S. Felice 45

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

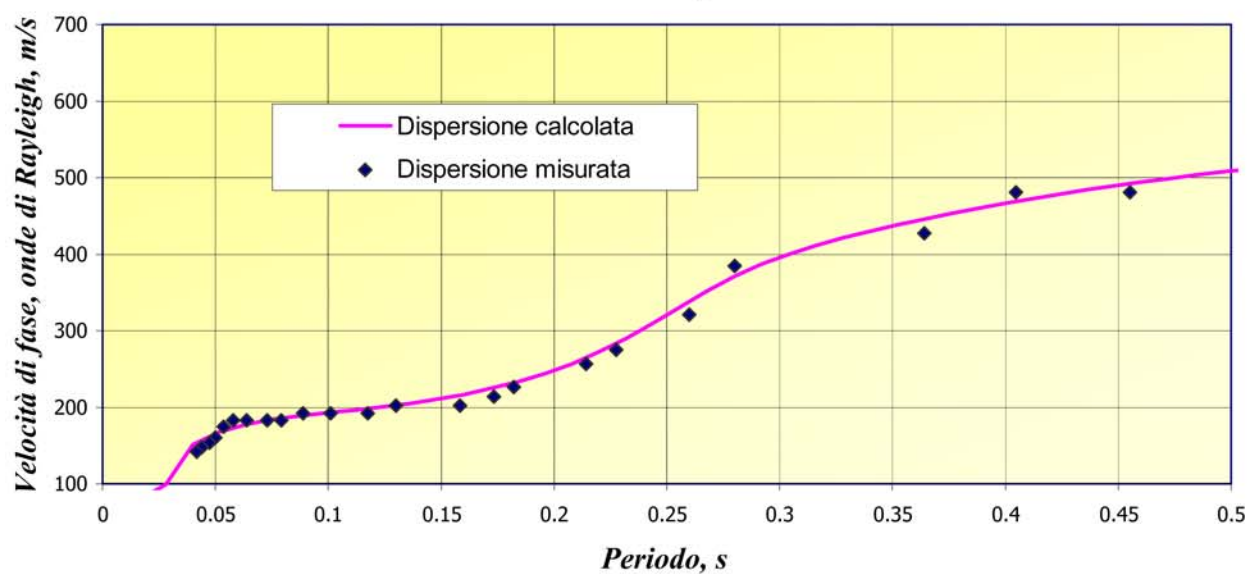
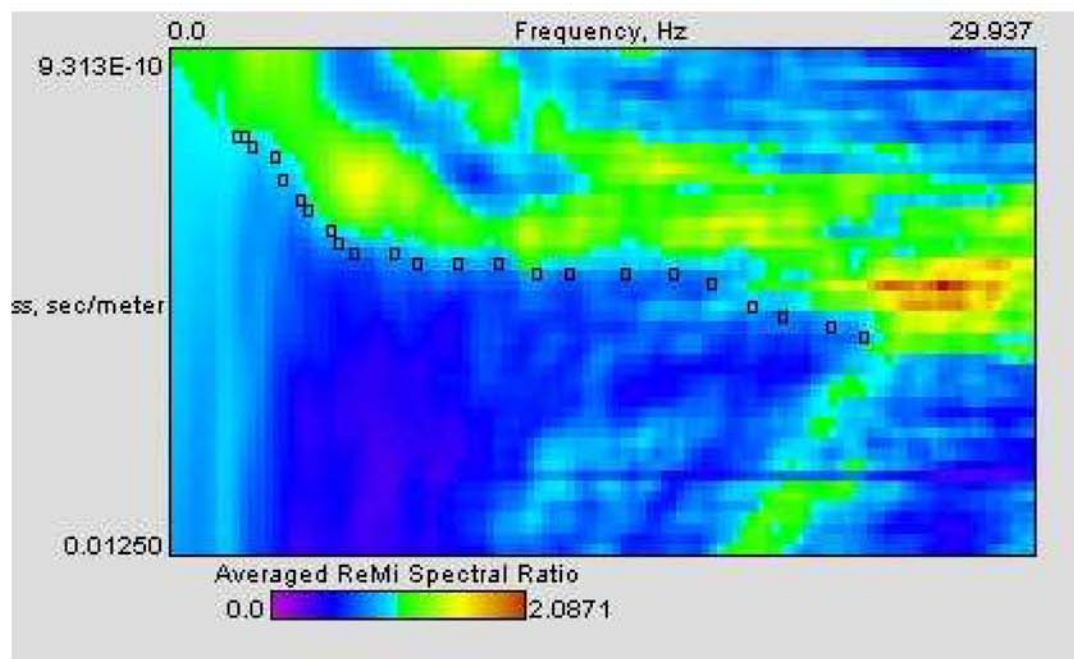


grafico slowness/frequenza



**REGIONE
TOSCANA**



**Direzione Generale delle Politiche
Territoriali e Ambientali
Coordinamento Regionale Prevenzione Sismica**



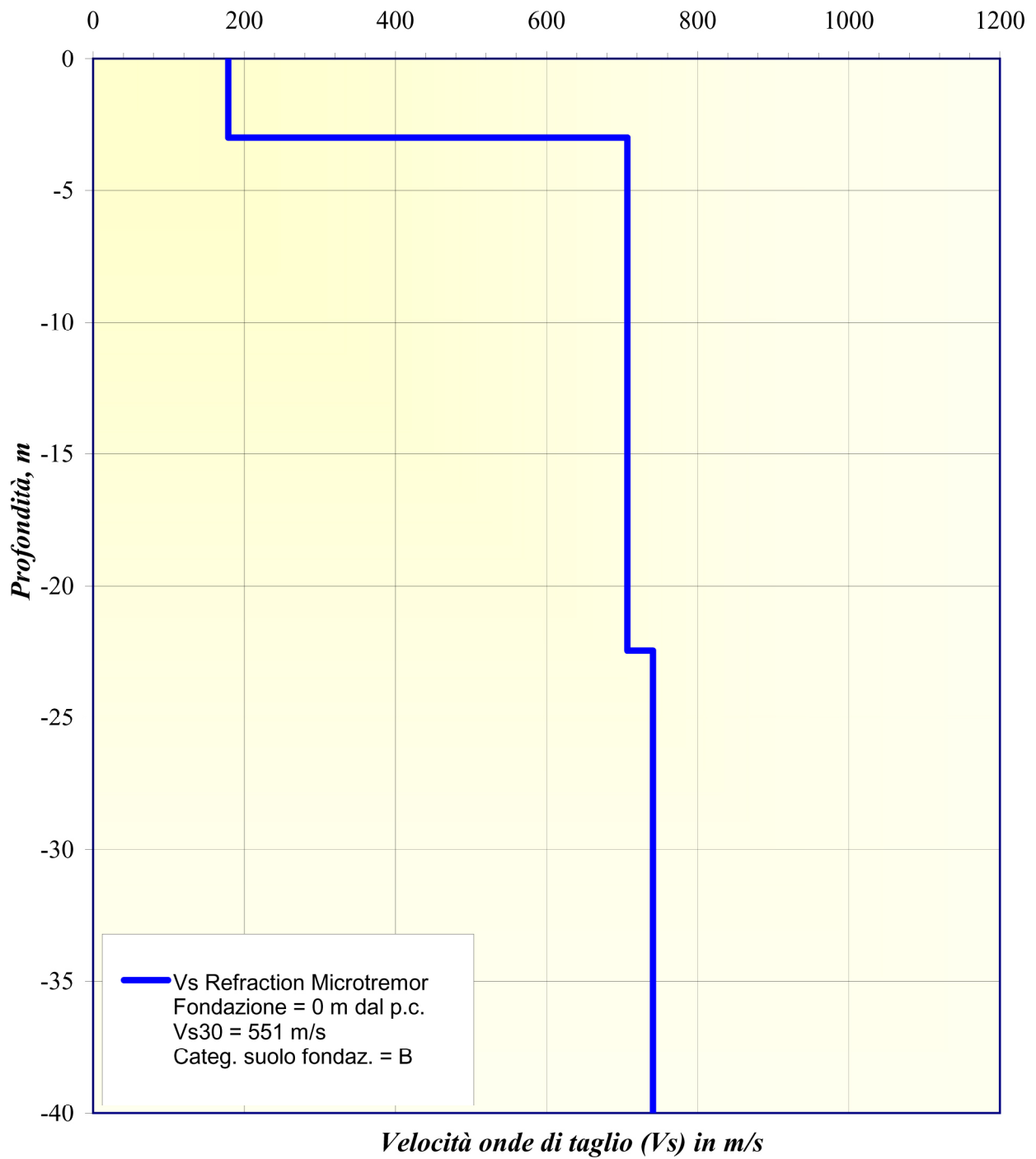
**MICROZONAZIONE SISMICA
DELLA CONCA AQUILANA
(terremoto 06-04-2009)**

Relazione tecnica finale di sintesi - Macroarea 9

**VALLE E CAVALLETTO - PROVE MASW
E SISMICA PASSIVA (REMI)**

Cavalletto 16

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

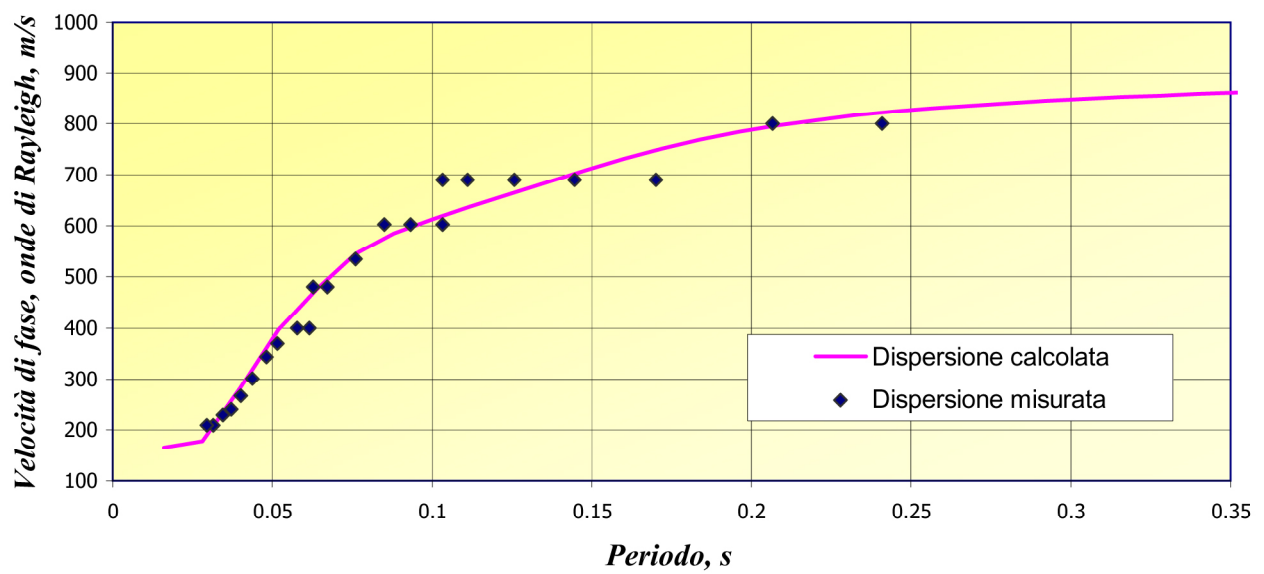
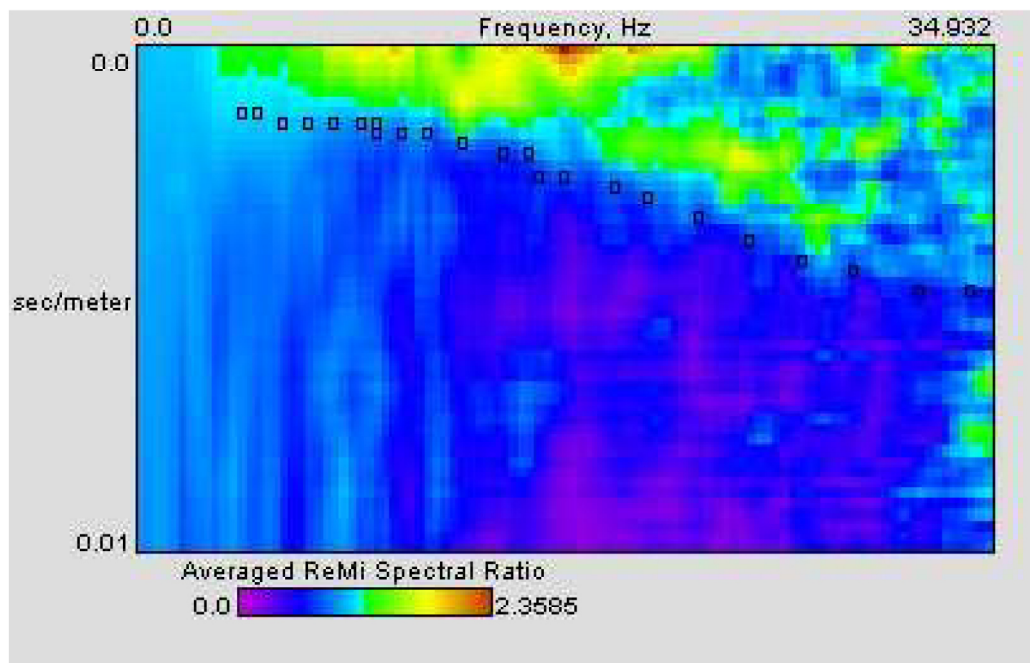
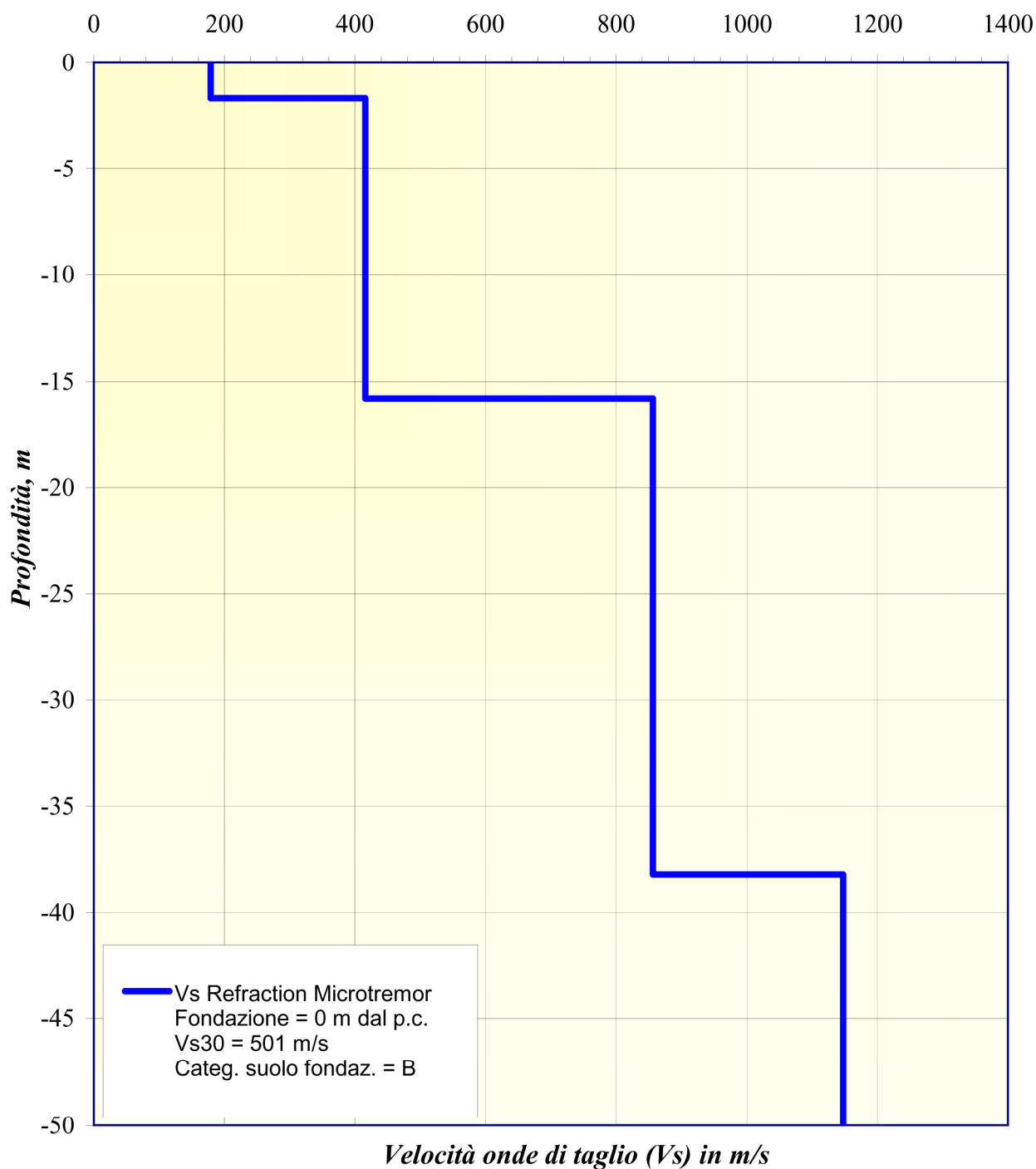


grafico slowness/frequenza



Cavalletto 17

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

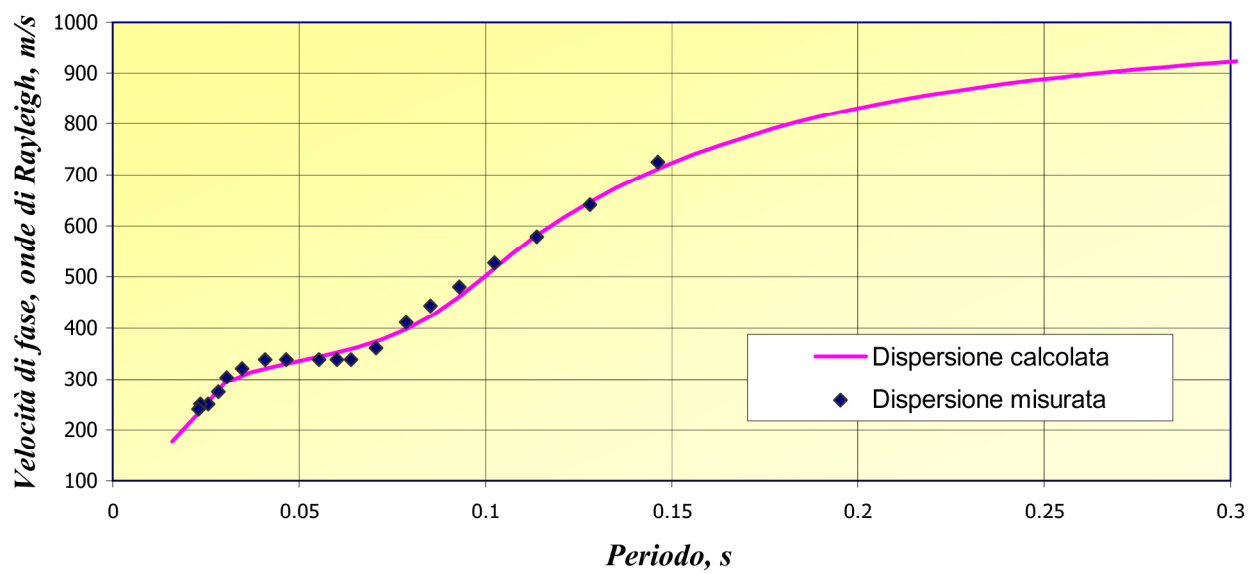
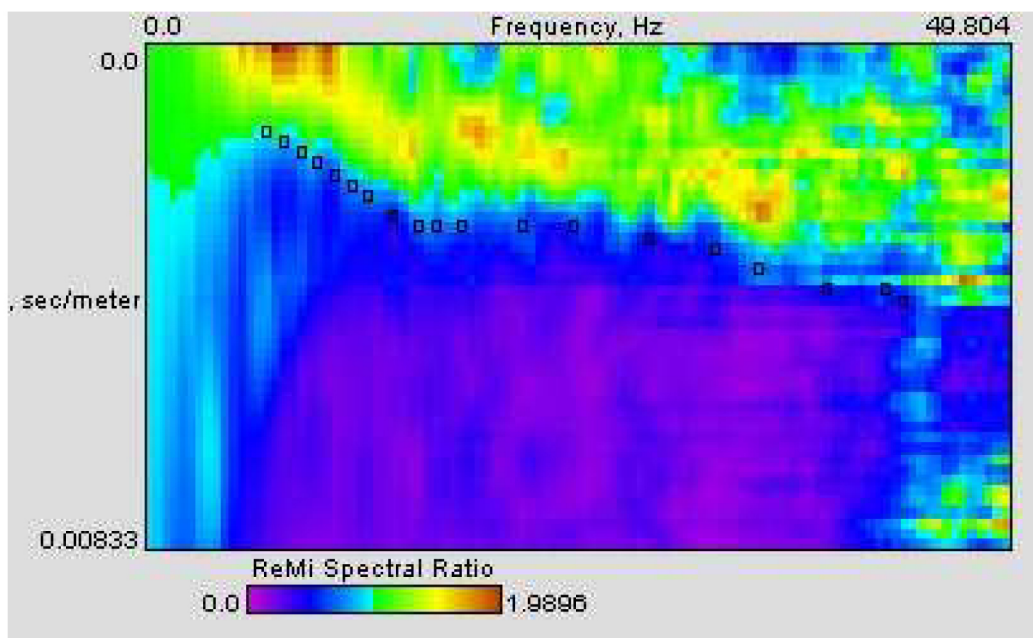
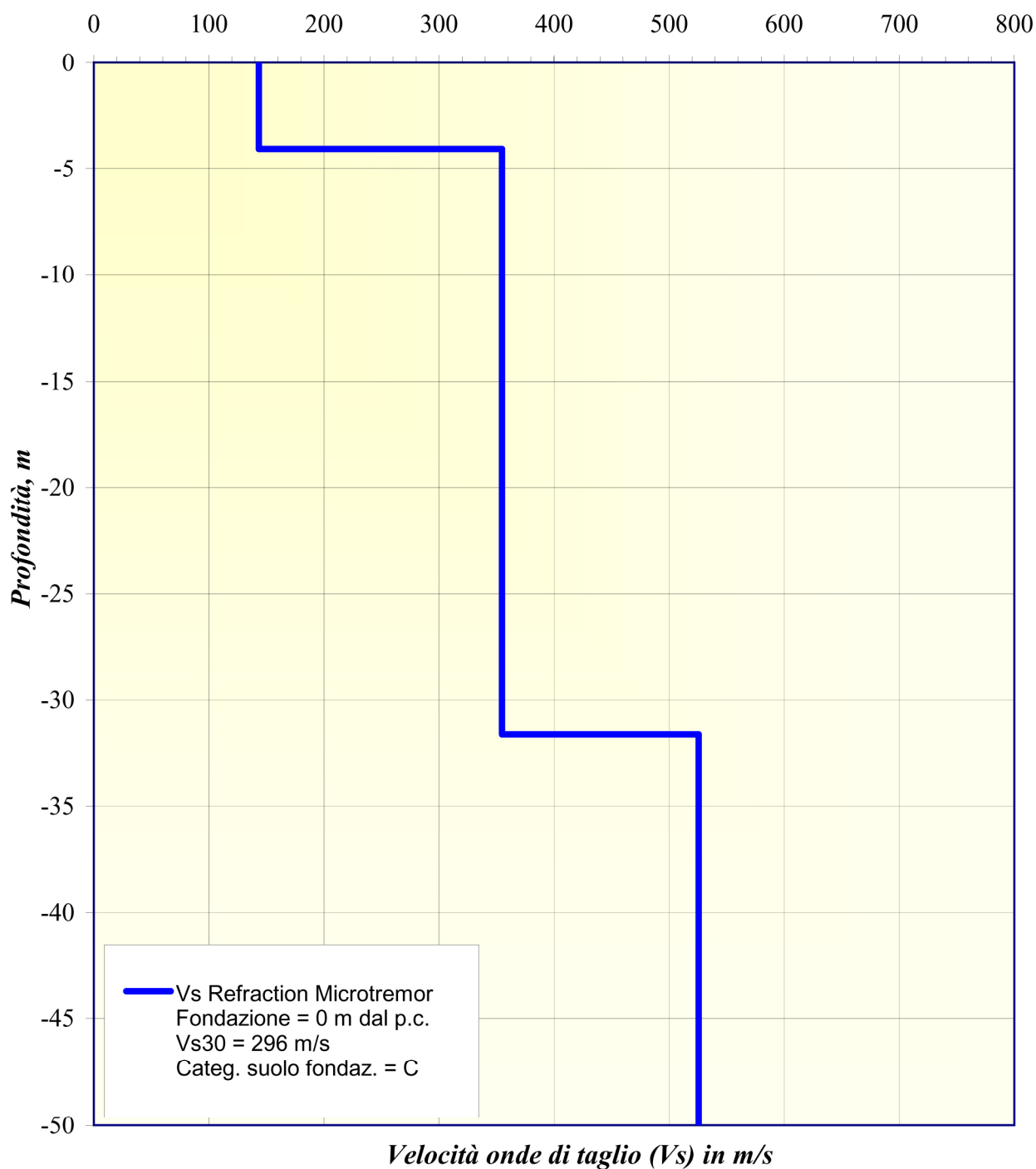


grafico slowness/frequenza



Cavalletto 18

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

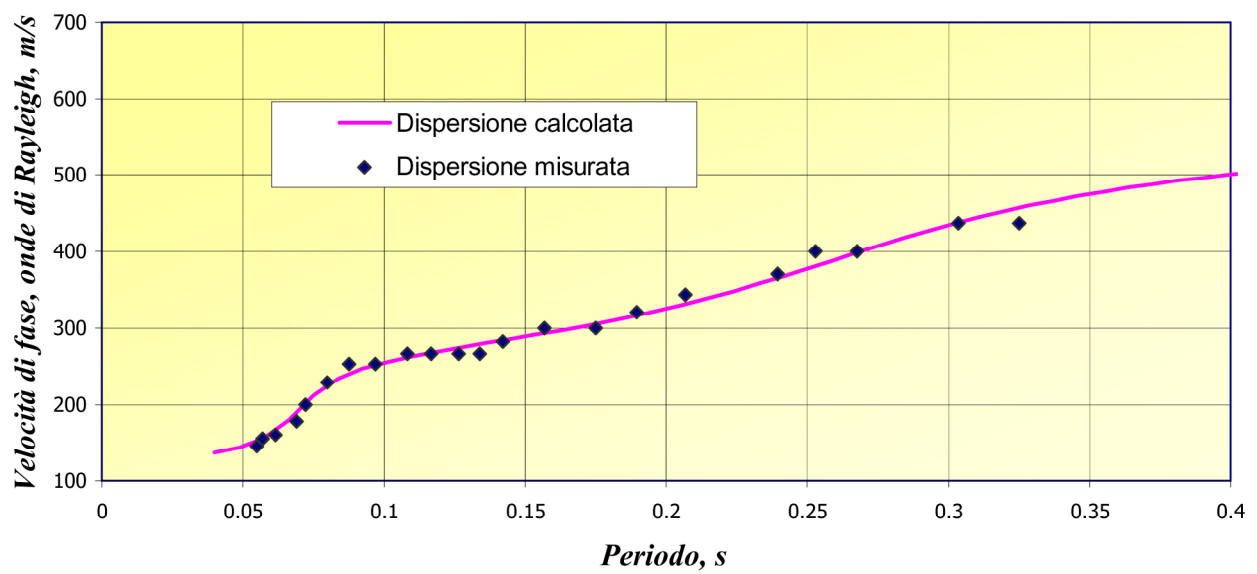
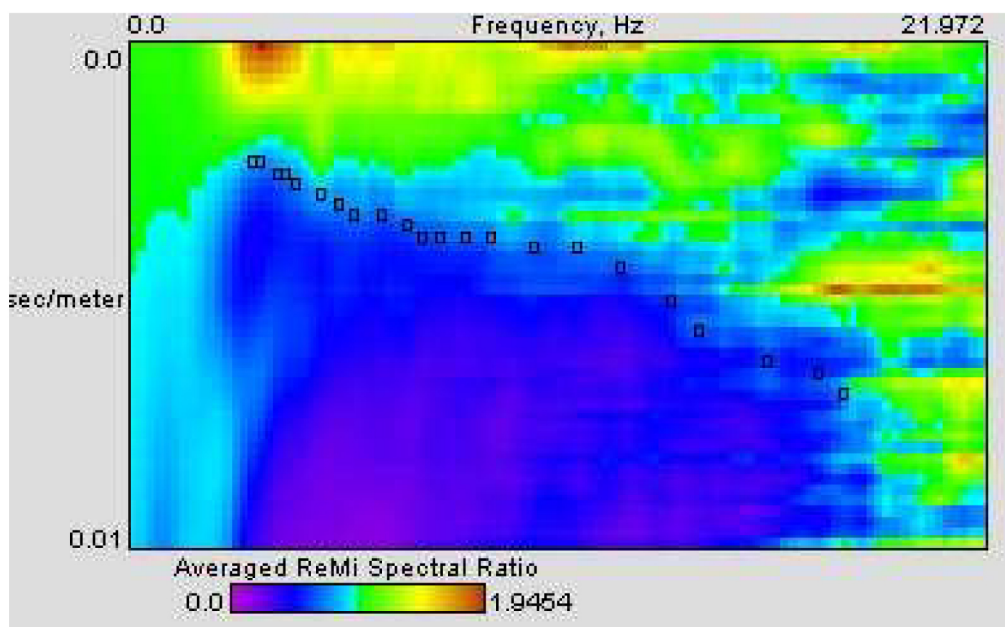
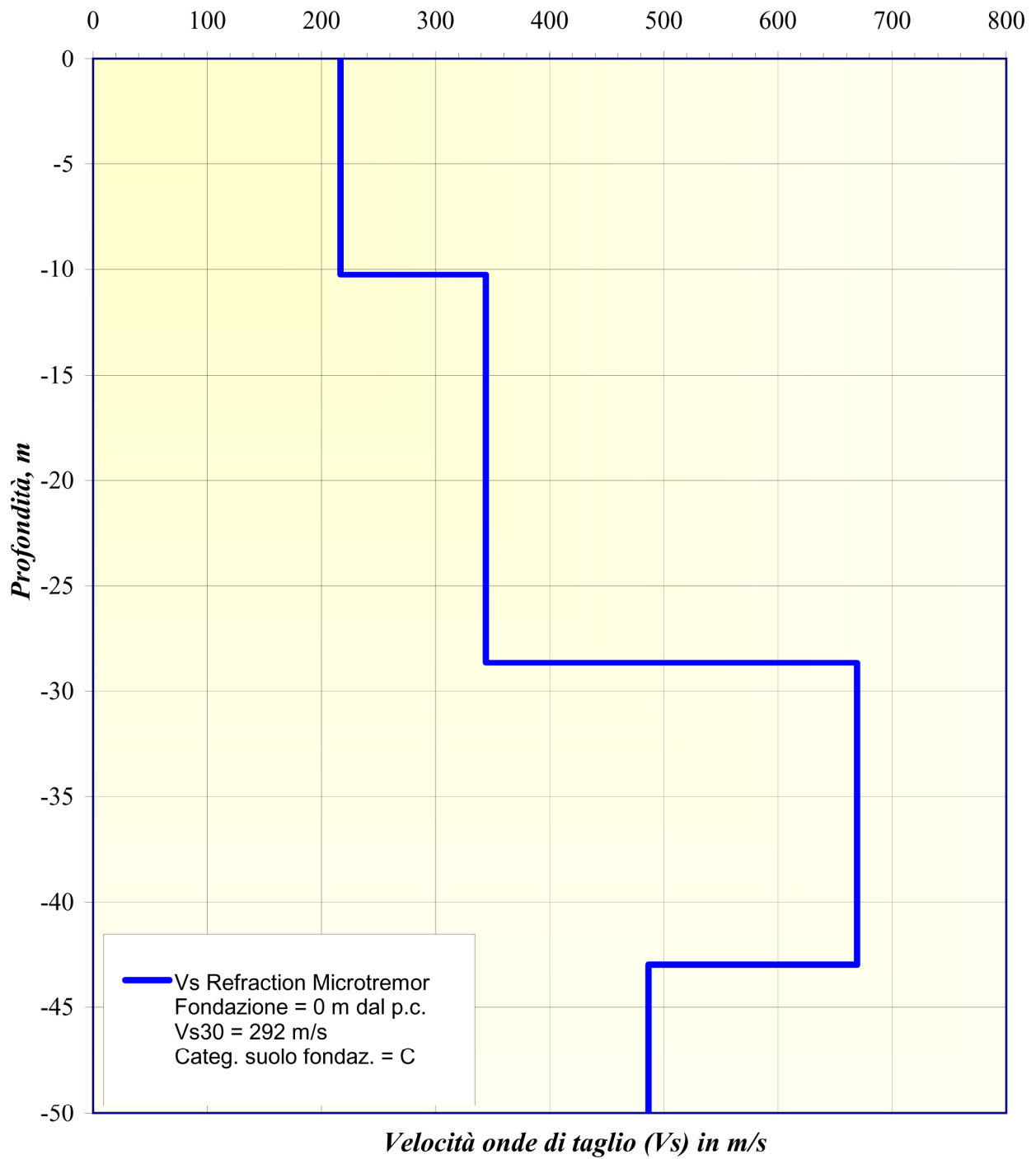


grafico slowness/frequenza



Cavalletto 19

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

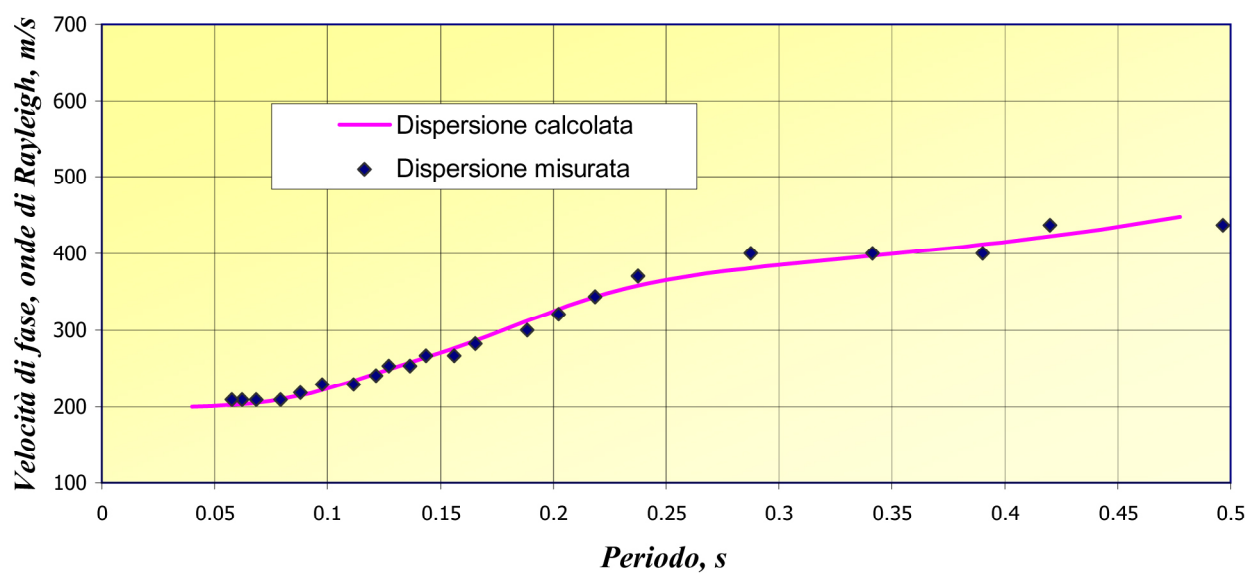
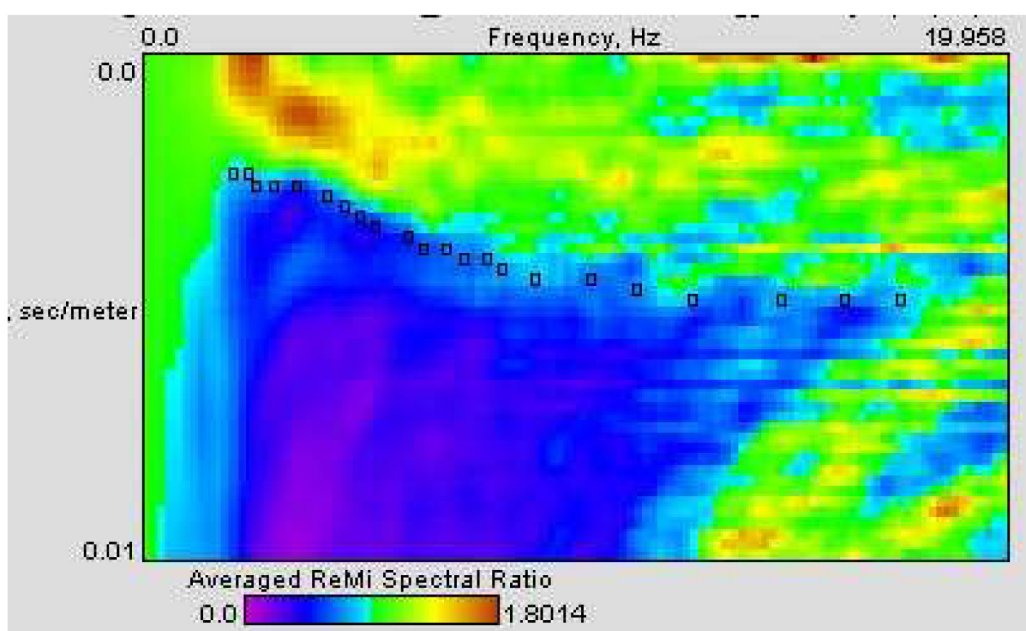
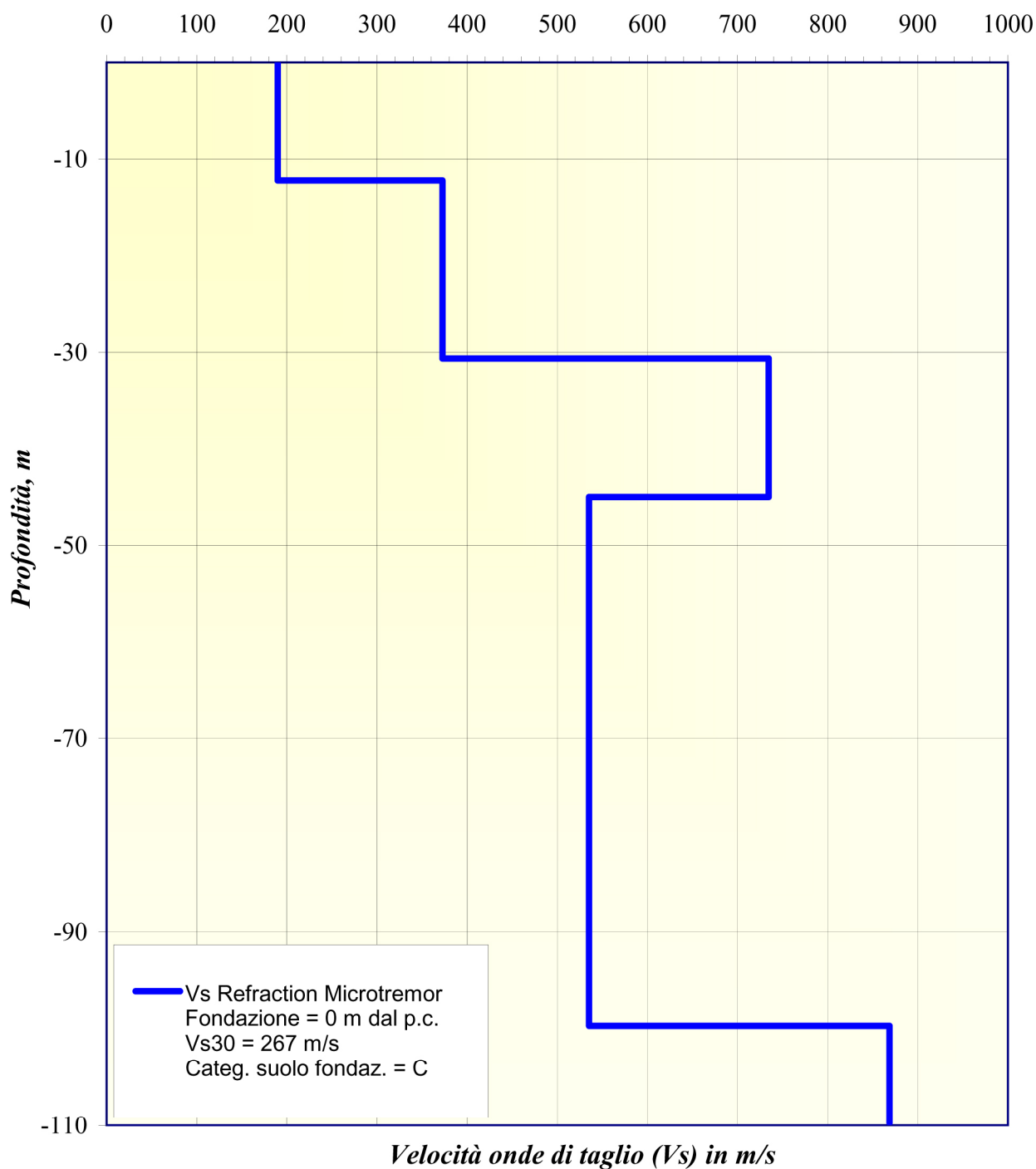


grafico slowness/frequenza



Cavalletto 20

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

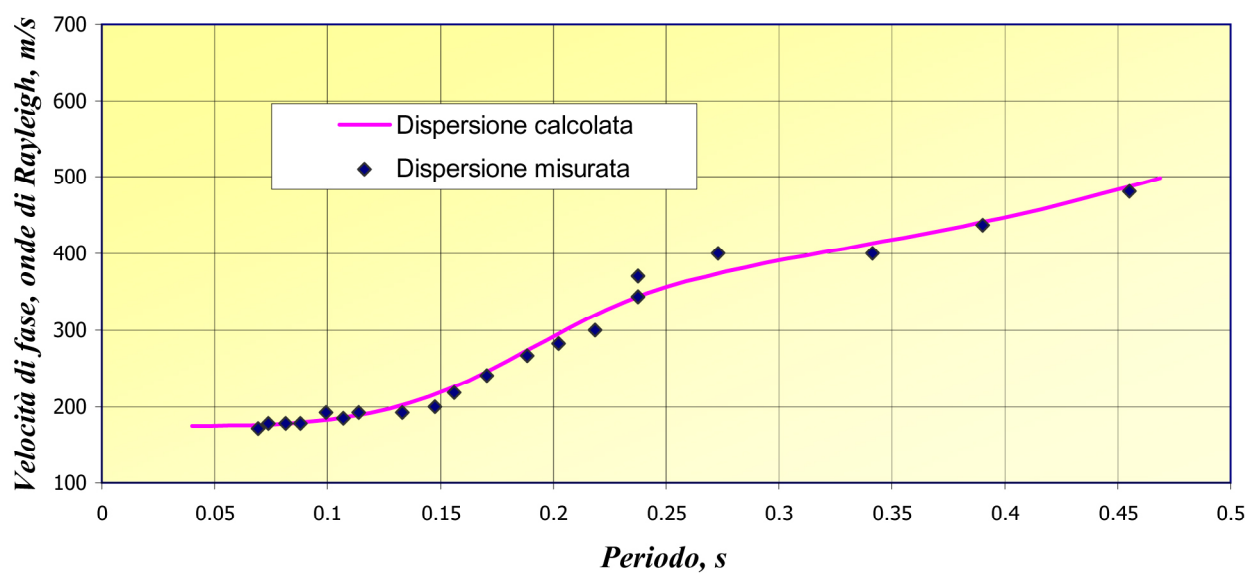
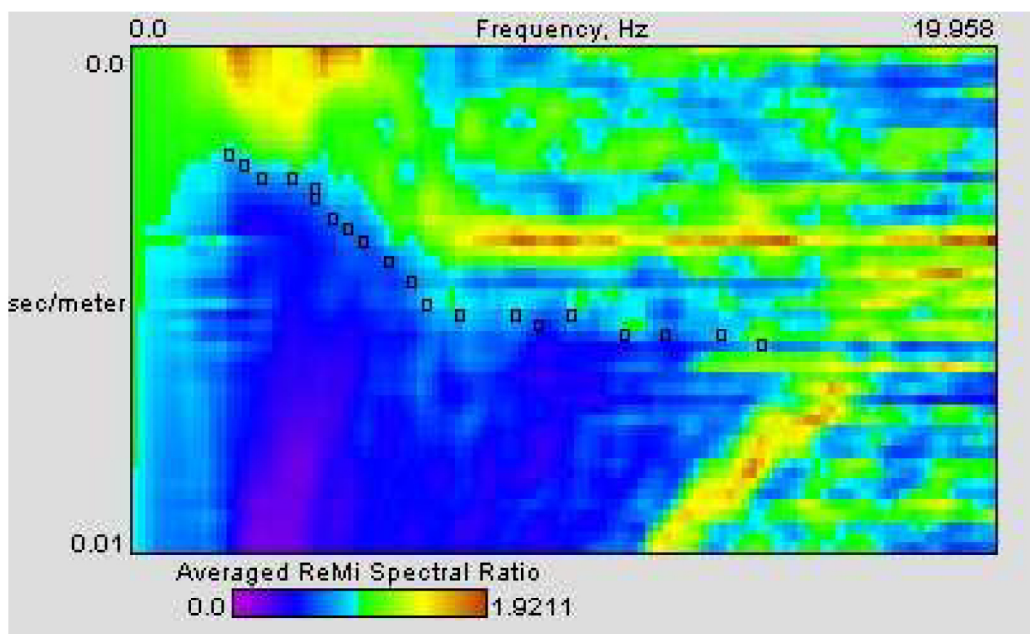
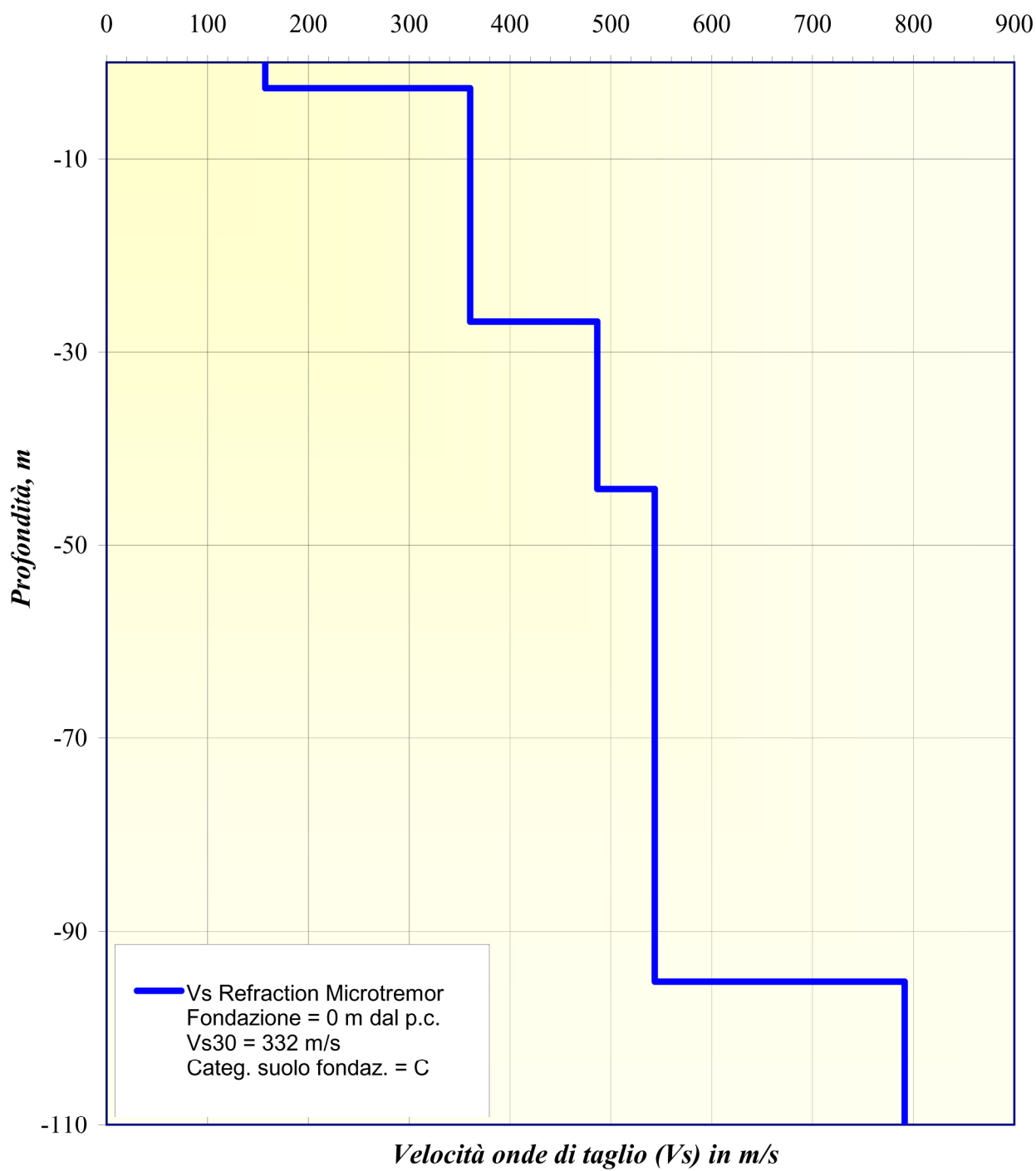


grafico slowness/frequenza



Cavalletto 21

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

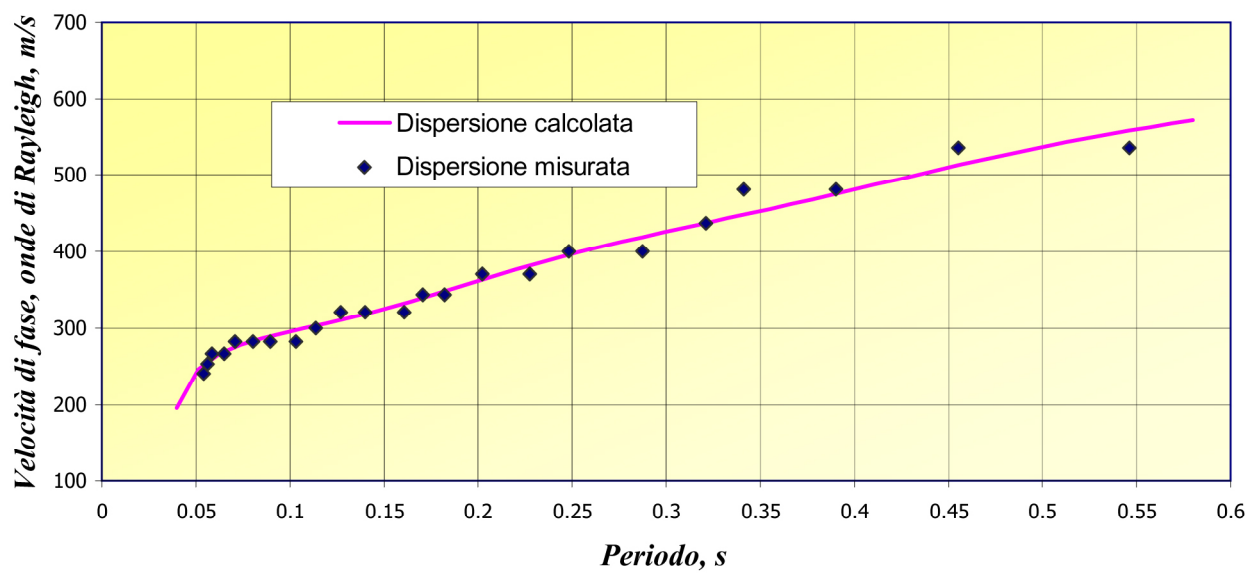
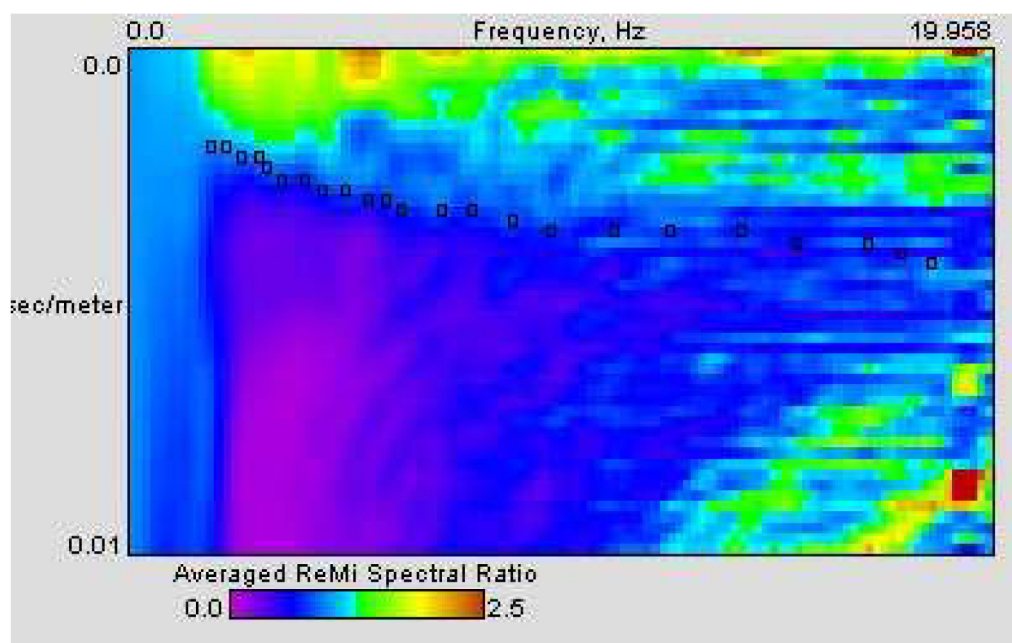


grafico slowness/frequenza



	indagine ReMi		indagine H/V		
nome	Cavalletto 1		Cavalletto 16		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	178	3	strumento difettoso; effettuata utilizzando componente orizzontale N-S		
2° livello	707	22.4			
3° livello	741	44.6			
4° livello	1025				
5° livello					
6° livello			3.4	601	44.2
Vs 30	551		Classe misura		C

	indagine ReMi		indagine H/V		
nome	Cavalletto 2				
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	178	1.6			
2° livello	415	15.8			
3° livello	856	38.2			
4° livello	1147				
5° livello					
6° livello					
Vs 30	501				

	indagine ReMi		indagine H/V		
nome	Cavalletto 3		Cavalletto 18		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	143.5	4	fs non chiara; un picco rilevante solo a 71 Hz		
2° livello	354.9	31.6			
3° livello	525.6	53.4			
4° livello	688.2				
5° livello					
6° livello					
Vs 30	296		Classe misura		A

	indagine ReMi		indagine H/V		
nome	Cavalletto 4		Cavalletto 19		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	216	10.2	strumento difettoso; effettuata utilizzando componente orizzontale N-S		
2° livello	344	28.6			
3° livello	669	42.9			
4° livello	486	99.5			
5° livello	738				
6° livello			1.1	417	94.8
Vs 30	292		Classe misura		C

	indagine ReMi		indagine H/V		
nome	Cavalletto 5		Cavalletto 20		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	189	12.2			
2° livello	372	30.6			
3° livello	734	44.9			
4° livello	535	99.8			
5° livello	868				
6° livello			1	423	105.7
Vs 30	267		Classe misura		A

	indagine ReMi		indagine H/V		
nome	Cavalletto 6		Cavalletto 21		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	157	2.6			
2° livello	360	26.8			
3° livello	486	44.2			
4° livello	543	95.2			
5° livello	791				
6° livello			1.1	425	96.6
Vs 30	292				

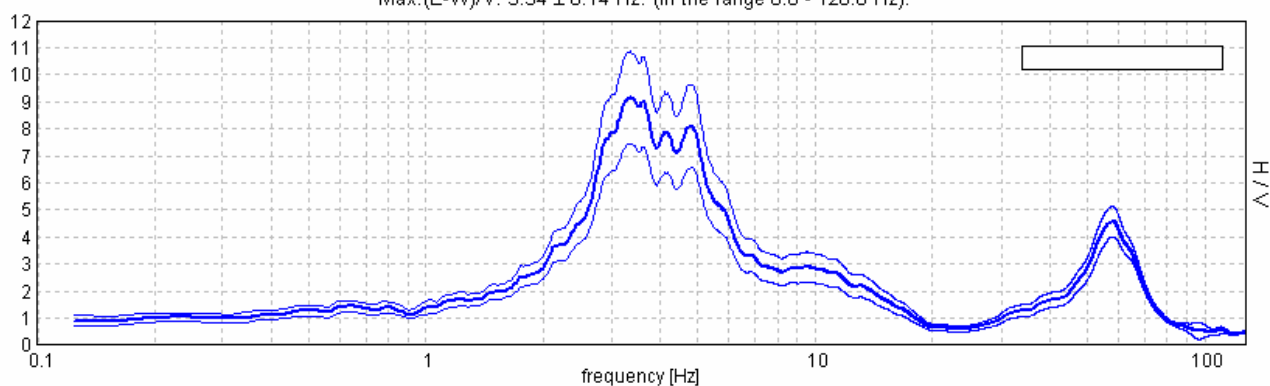
CAVALLETTO, 16

Start recording: 02/07/09 16:36:41 End recording: 02/07/09 17:04:42
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

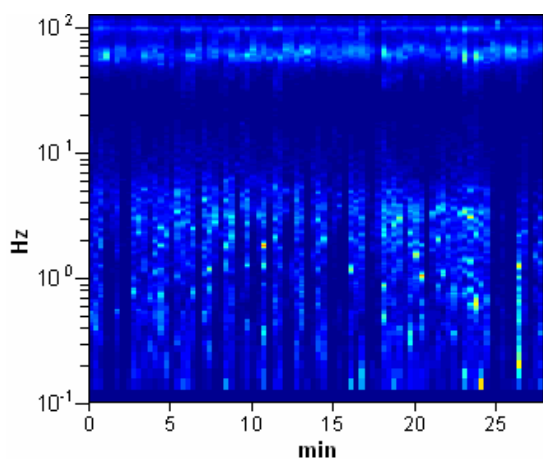
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

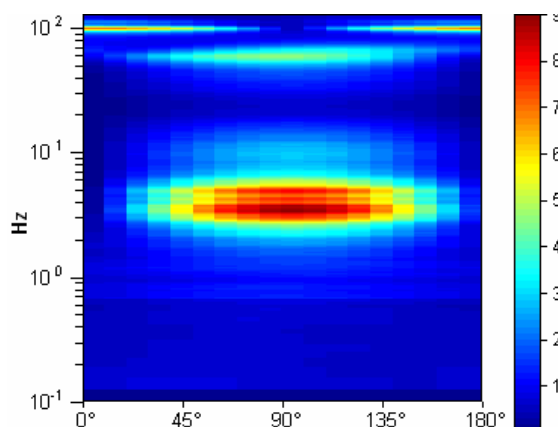
Max. (E-W)/V: 3.34 ± 0.14 Hz. (In the range 0.0 - 128.0 Hz).



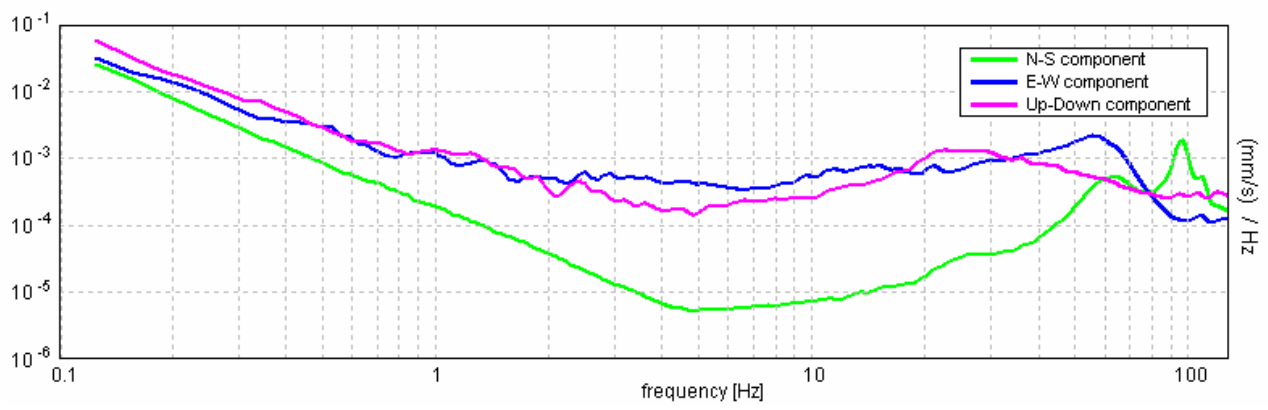
H/V TIME HISTORY



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 59.16 ± 1.98 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$59.16 > 0.50$	OK	
$n_c(f_0) > 200$	$99382.5 > 200$	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 2840 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	51.063 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	76.406 Hz	OK	
$A_0 > 2$	$2.18 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01673 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.98986 < 2.95781$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.0865 < 1.58$	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

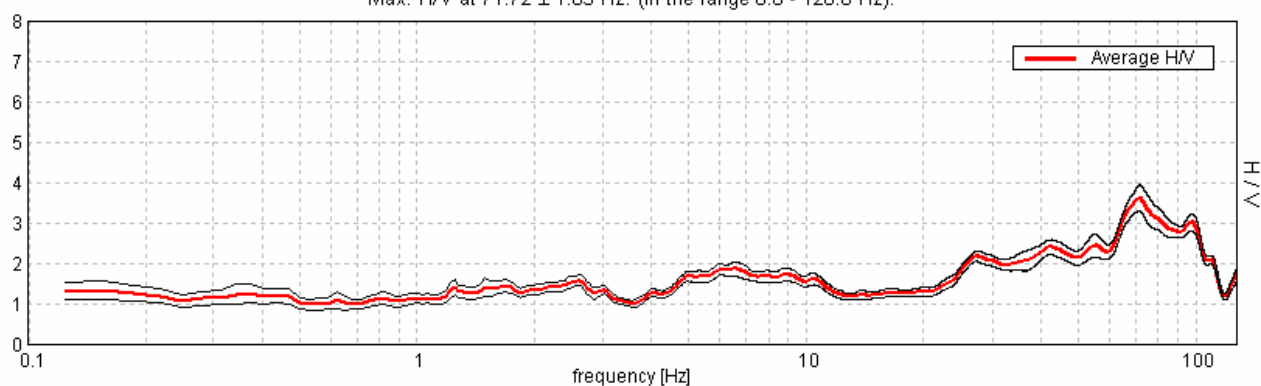
CAVALLETTO, 18

Start recording: 02/07/09 17:36:08 End recording: 02/07/09 18:04:09
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

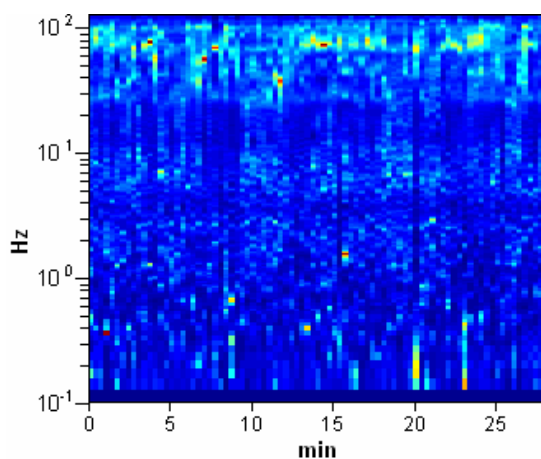
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

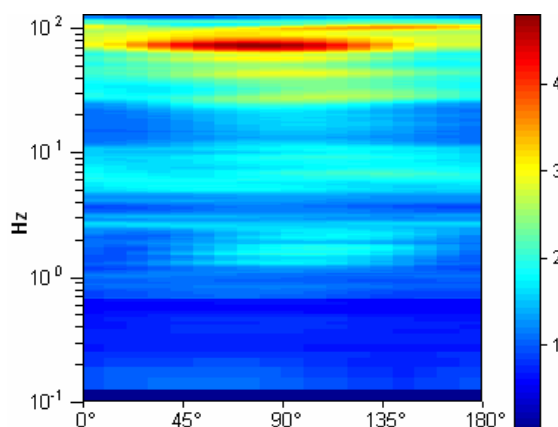
Max. H/V at 71.72 ± 1.85 Hz. (In the range 0.0 - 128.0 Hz).



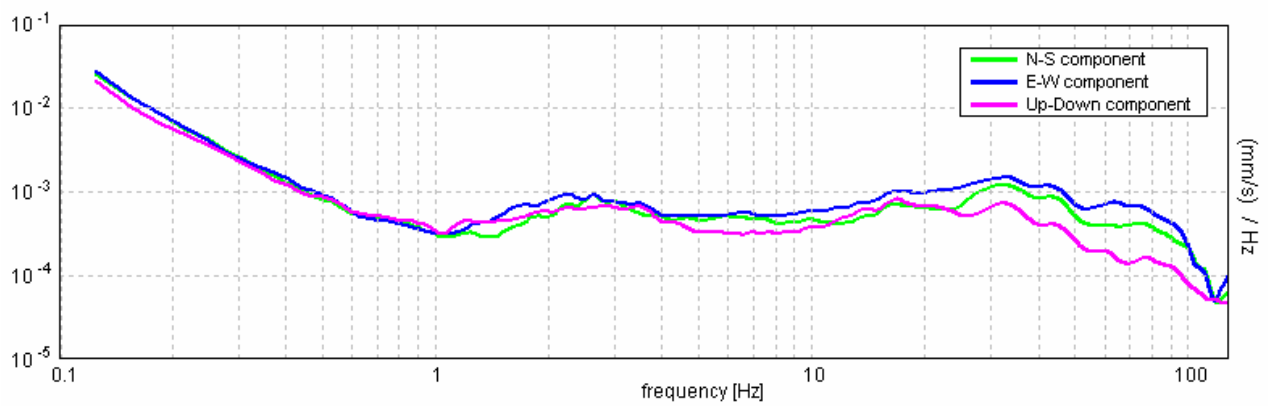
H/V TIME HISTORY



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 71.72 ± 1.85 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$71.72 > 0.50$	OK	
$n_c(f_0) > 200$	$120487.5 > 200$	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 2950 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	24.813 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	113.031 Hz	OK	
$A_0 > 2$	$3.62 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01292 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.92657 < 3.58594$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1608 < 1.58$	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

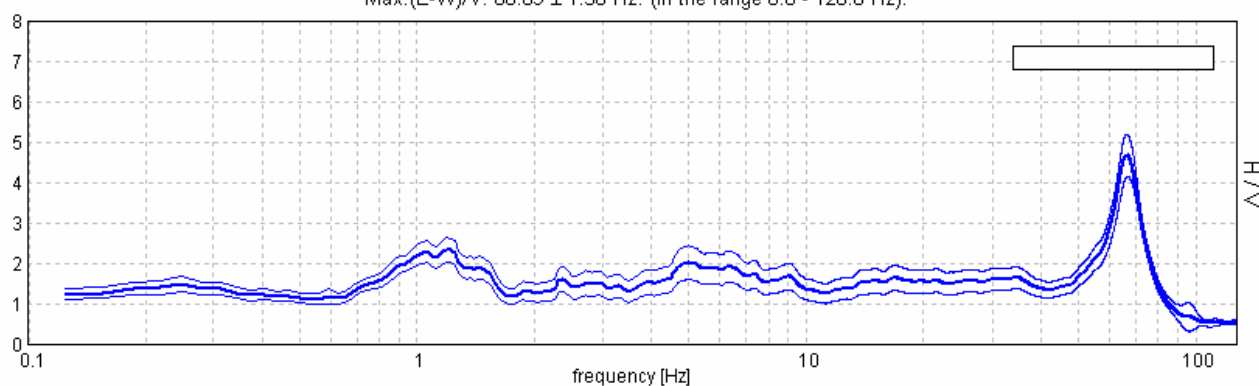
CAVALLETTO, 19

Start recording: 03/07/09 08:07:35 End recording: 03/07/09 08:35:36
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

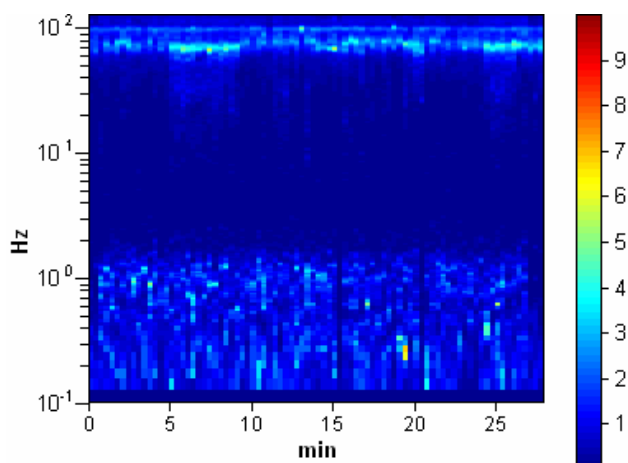
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

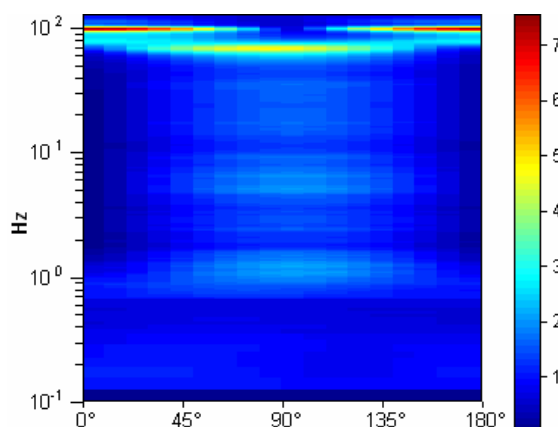
Max. (E-W)/V: 66.69 ± 1.56 Hz. (In the range 0.0 - 128.0 Hz).



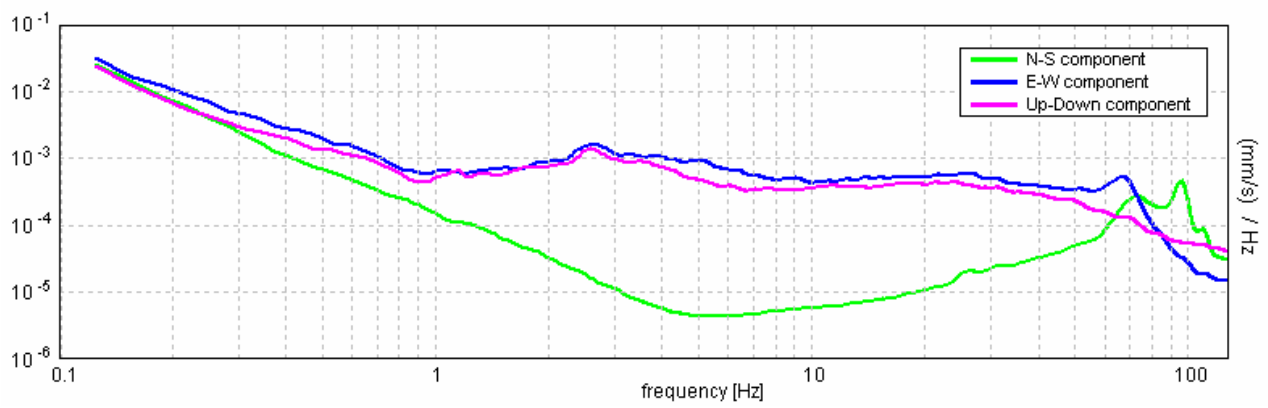
H/V TIME HISTORY



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 70.56 ± 1.34 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$70.56 > 0.50$	OK	
$n_c(f_0) > 200$	$118545.0 > 200$	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 2968 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	60.688 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	101.0 Hz	OK	
$A_0 > 2$	$2.69 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00948 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.66908 < 3.52813$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.0911 < 1.58$	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

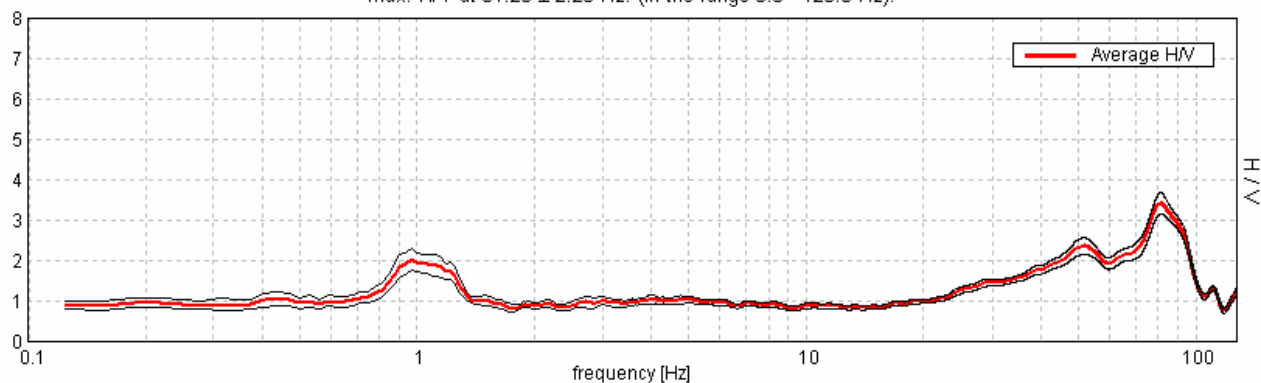
CAVALLETTO, 20

Start recording: 03/07/09 08:46:03 End recording: 03/07/09 09:14:04
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

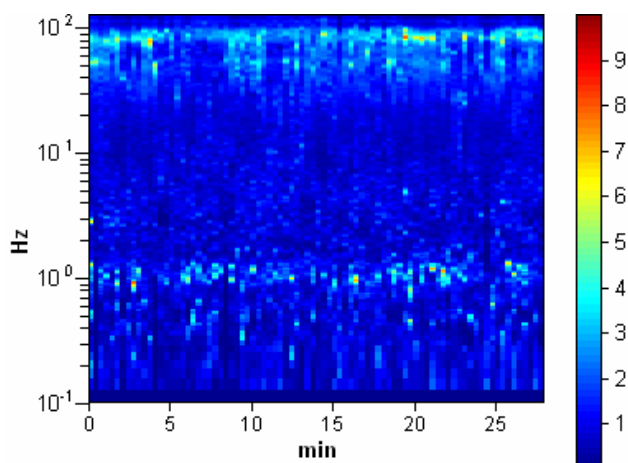
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

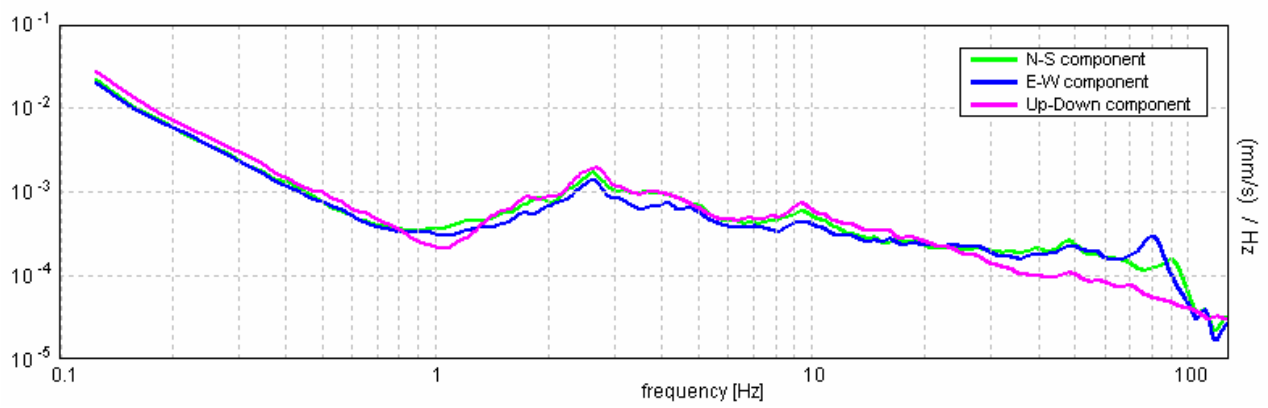
Max. H/V at 81.25 ± 2.26 Hz. (In the range 0.0 - 128.0 Hz).



H/V TIME HISTORY



SINGLE COMPONENT SPECTRA



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

Max. H/V at 81.25 ± 2.26 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	81.25 > 0.50	OK	
$n_c(f_0) > 200$	136500.0 > 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 2797 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	37.656 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	98.781 Hz	OK	
$A_0 > 2$	3.43 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01388 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	1.12802 < 4.0625	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.1318 < 1.58	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

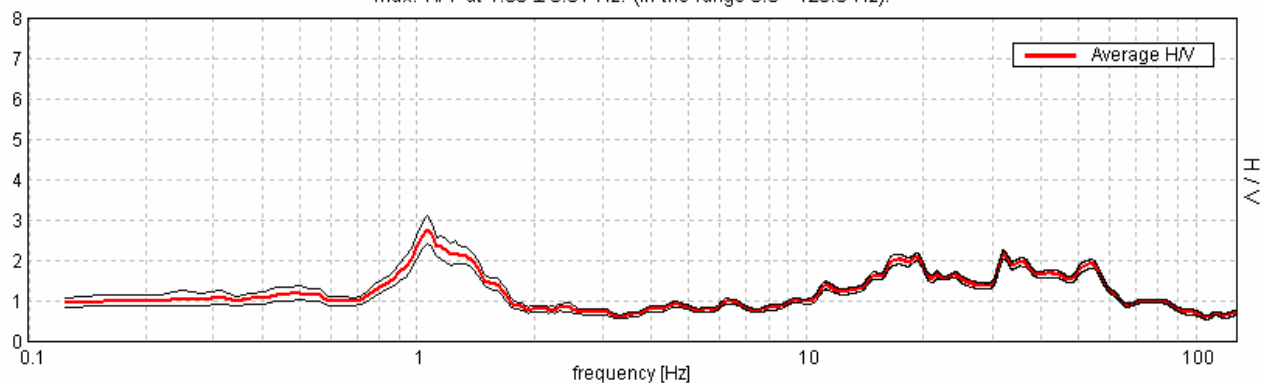
CAVALLETTO, 21

Start recording: 03/07/09 09:41:04 End recording: 03/07/09 10:09:04
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

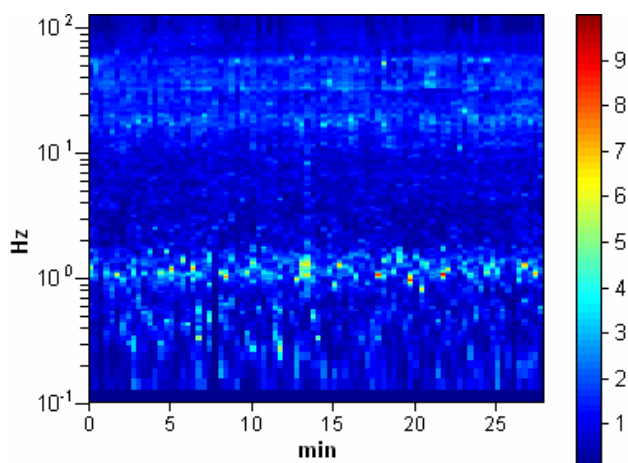
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

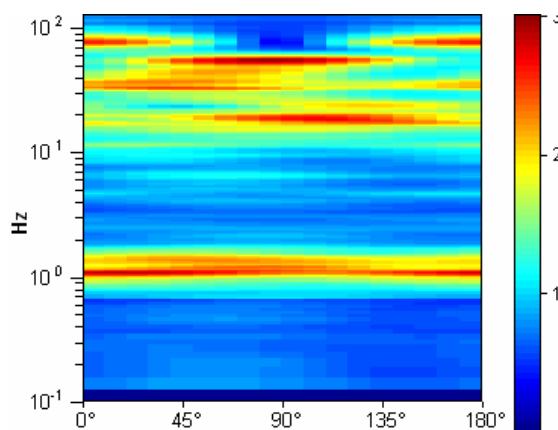
Max. H/V at 1.06 ± 0.01 Hz. (In the range 0.0 - 128.0 Hz).



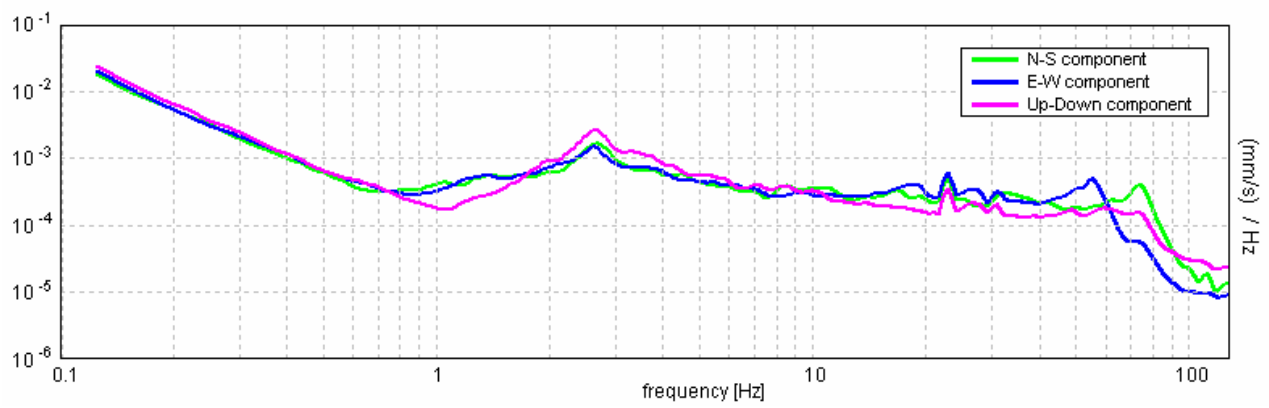
H/V TIME HISTORY



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 1.06 ± 0.01 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$1.06 > 0.50$	OK	
$n_c(f_0) > 200$	$1785.0 > 200$	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 52 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	0.813 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	1.656 Hz	OK	
$A_0 > 2$	$2.78 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.0026 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.00276 < 0.10625$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1701 < 1.78$	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

	indagine ReMi		indagine H/V		
nome	Valle 1		Valle 1		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	77	2.1			
2° livello	174	18.4			
3° livello	459	46.4			
4° livello	540				
5° livello					
6° livello			2.4	156	16.7
Vs 30	205		Classe misura		A

	indagine ReMi		indagine H/V		
nome	Valle 2		Valle 2		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	131	1.4			
2° livello	662	2.3			
3° livello	562	16.3			
4° livello	605				
5° livello					
6° livello			3.7	490	33
Vs 30	502		Classe misura		A

	indagine ReMi		indagine H/V		
nome	Valle 3		Valle 3		
	velocità Vs m/s	prof. letto m	fs con probabile bedrock sismico	Vs (m/s) media all'interfacc ia	H stimato (m)
1° livello	92	1			
2° livello	322	5.2			
3° livello	265	9.7			
4° livello	566	15.3			
5° livello	704				
6° livello			4.7	302	16.1
Vs 30	419		Classe misura		A

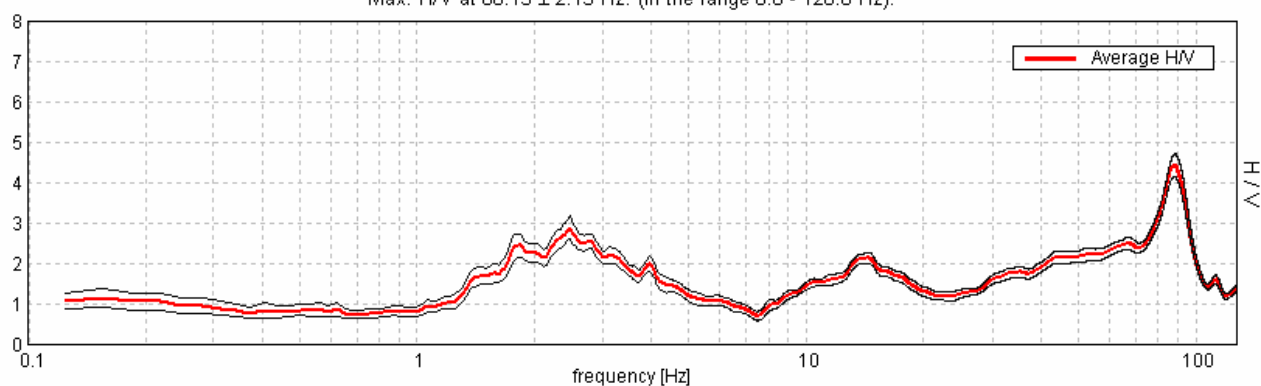
VALLE, 13

Start recording: 02/07/09 12:01:48 End recording: 02/07/09 12:29:49
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

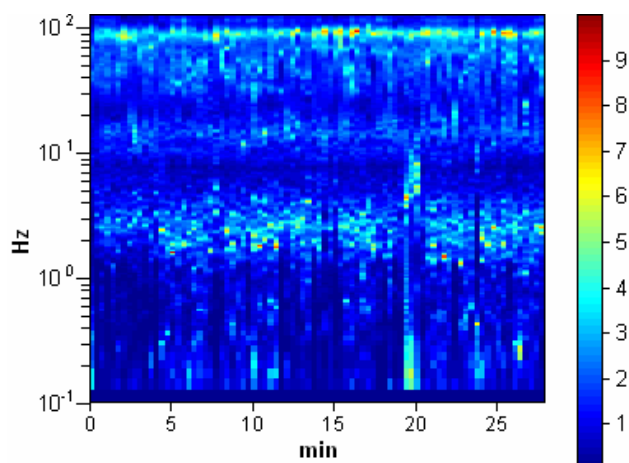
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

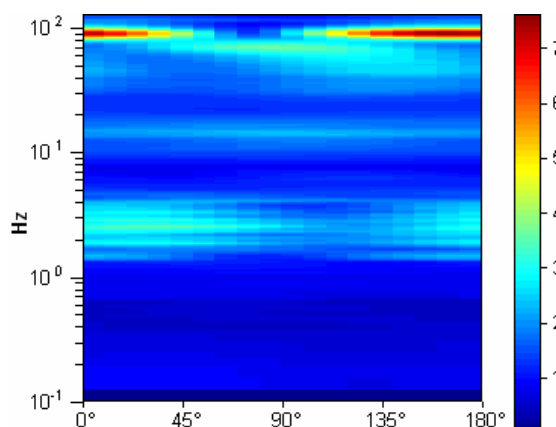
Max. H/V at 88.13 ± 2.15 Hz. (in the range 0.0 - 128.0 Hz).



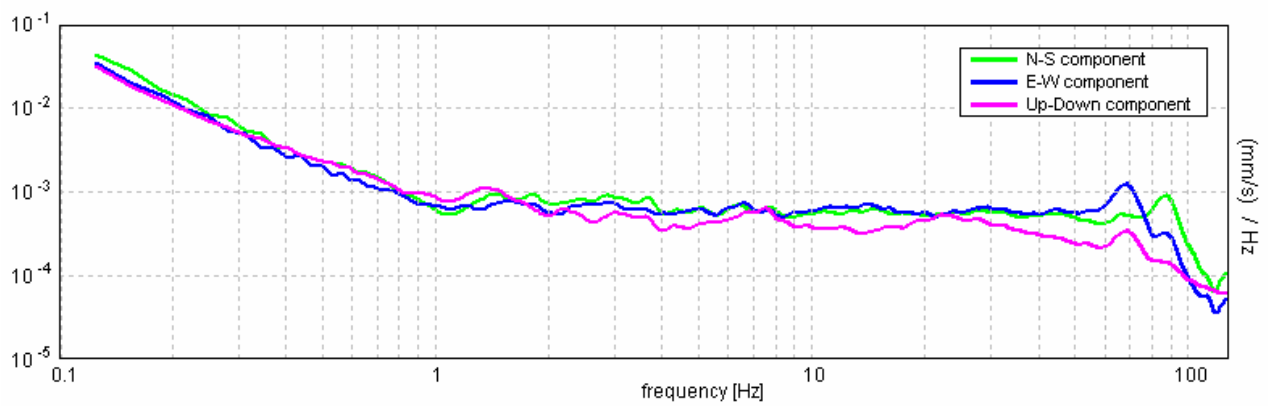
H/V TIME HISTORY



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 88.13 ± 2.15 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$88.13 > 0.50$	OK	
$n_c(f_0) > 200$	$148050.0 > 200$	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 2687 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	51.75 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	99.313 Hz	OK	
$A_0 > 2$	$4.44 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01217 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$1.07243 < 4.40625$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1363 < 1.58$	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

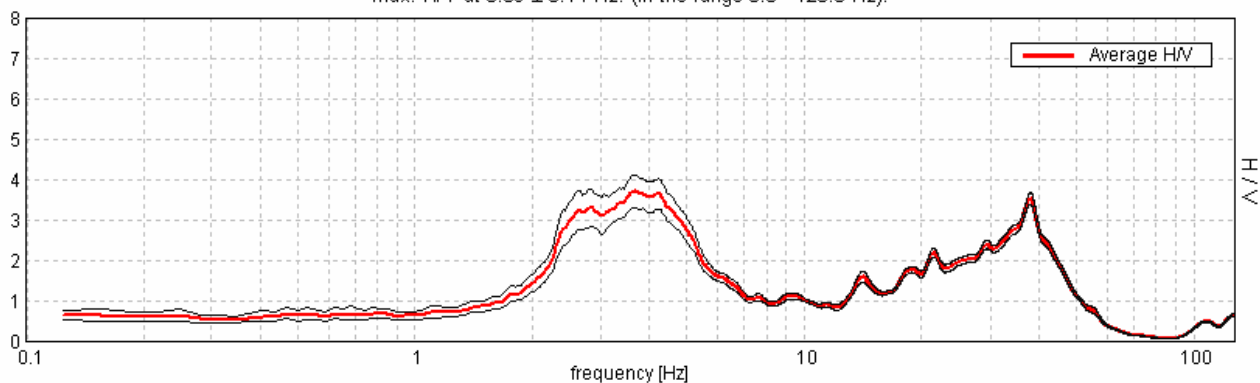
VALLE, 14

Start recording: 02/07/09 15:19:55 End recording: 02/07/09 15:47:55
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

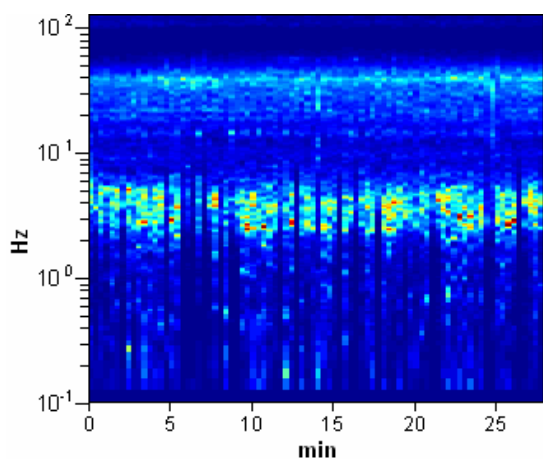
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

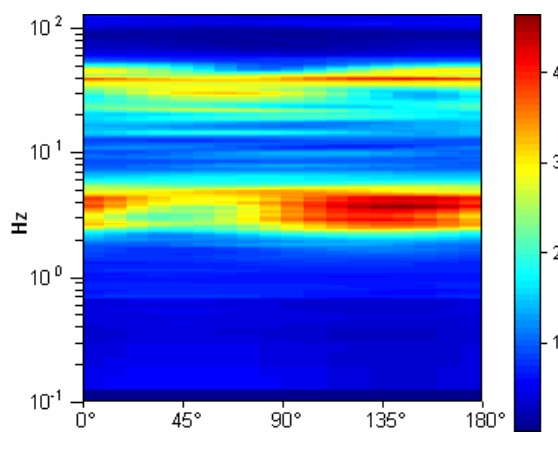
Max. H/V at 3.69 ± 0.14 Hz. (in the range 0.0 - 128.0 Hz).



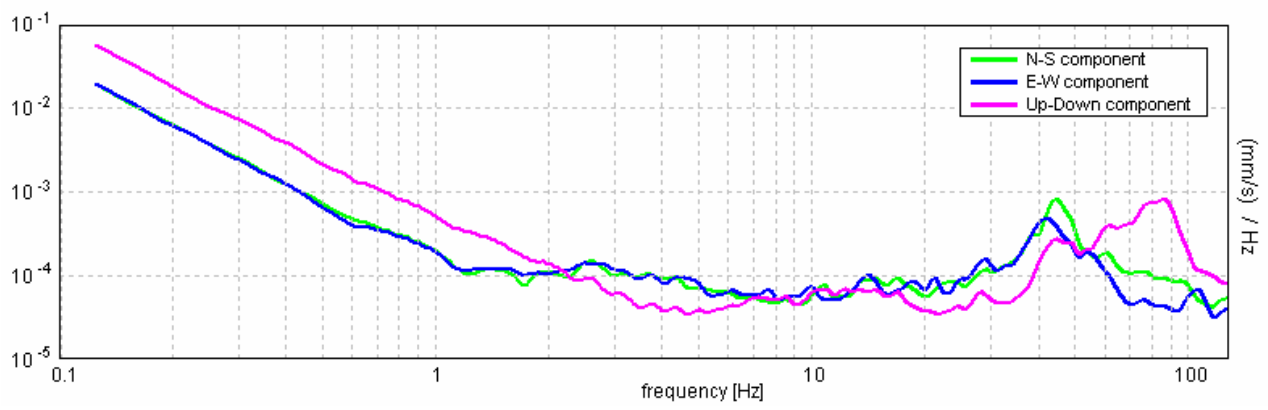
H/V TIME HISTORY



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 3.69 ± 0.14 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$3.69 > 0.50$	OK	
$n_c(f_0) > 200$	$6195.0 > 200$	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 178 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	2.188 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	5.656 Hz	OK	
$A_0 > 2$	$3.72 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01879 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.0693 < 0.18438$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.2009 < 1.58$	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

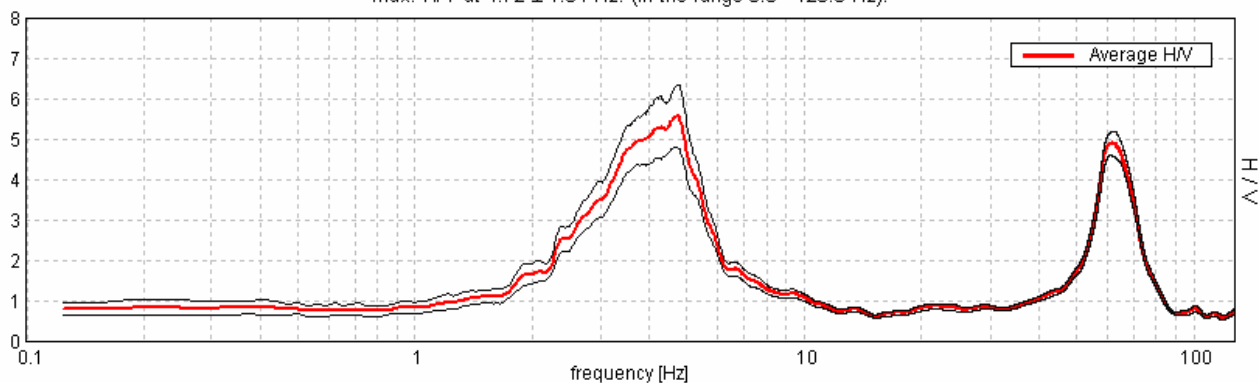
VALLE, 15

Start recording: 02/07/09 15:58:08 End recording: 02/07/09 16:26:08
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

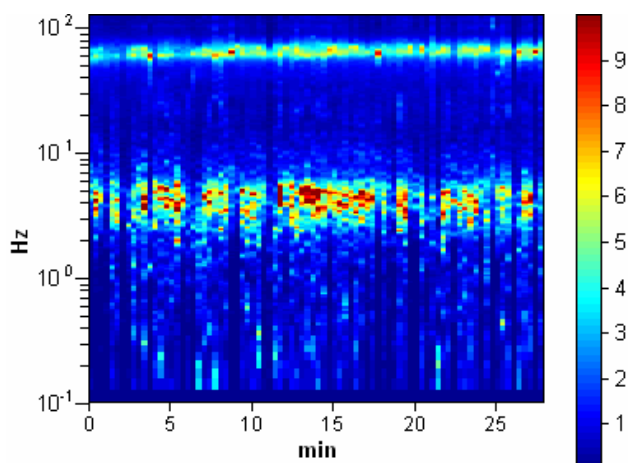
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

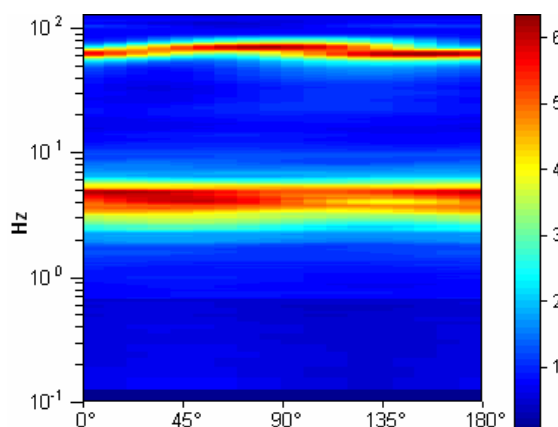
Max. H/V at 4.72 ± 1.84 Hz. (in the range 0.0 - 128.0 Hz).



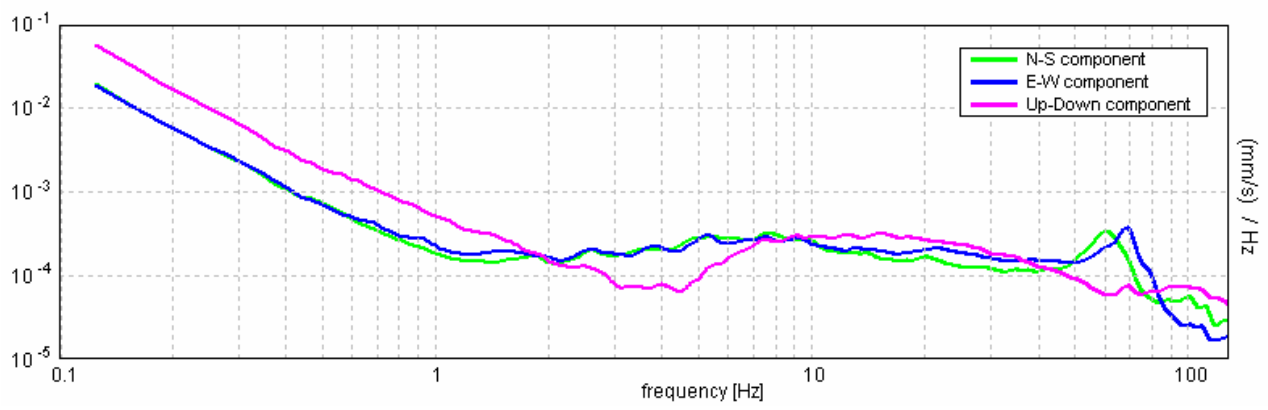
H/V TIME HISTORY



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 4.72 ± 1.84 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$4.72 > 0.50$	OK	
$n_c(f_0) > 200$	$7927.5 > 200$	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 228 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	2.563 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	5.813 Hz	OK	
$A_0 > 2$	$5.58 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.19509 < 0.05$		NO
$\sigma_f < \varepsilon(f_0)$	$0.92059 < 0.23594$		NO
$\sigma_A(f_0) < \theta(f_0)$	$0.3825 < 1.58$	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

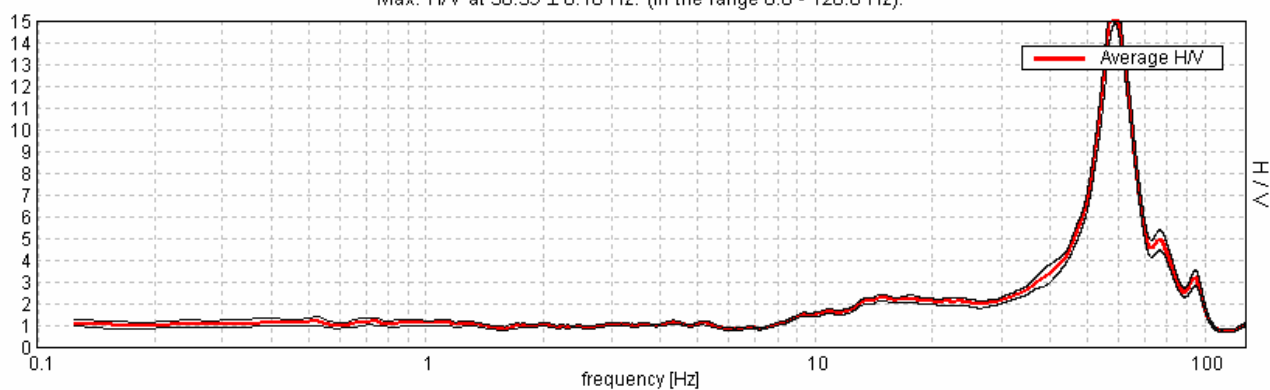
VALLE 44

Start recording: 22/07/09 17:14:03 End recording: 22/07/09 17:40:03
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

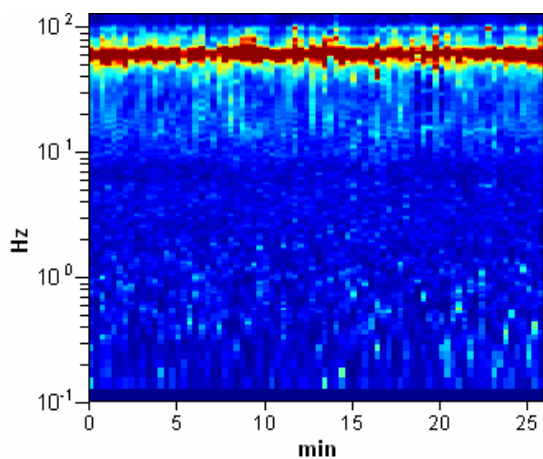
Trace length: 0h26'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

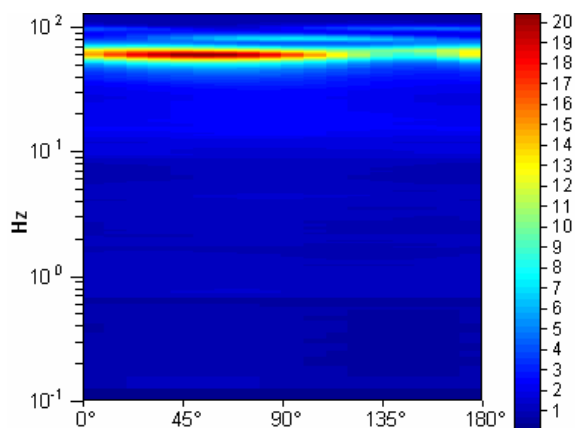
Max. H/V at 58.59 ± 0.16 Hz. (in the range 0.0 - 128.0 Hz).



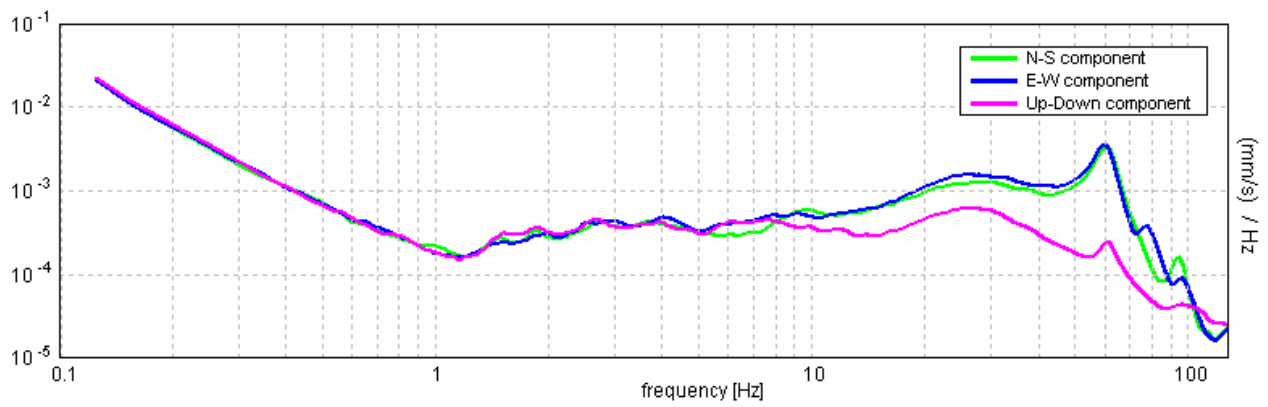
H/V TIME HISTORY



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 58.59 ± 0.16 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	58.59 > 0.50	OK	
$n_c(f_0) > 200$	91406.3 > 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 2814 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	51.125 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	67.188 Hz	OK	
$A_0 > 2$	15.60 > 2	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00137 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	0.08038 < 2.92969	OK	
$\sigma_A(f_0) < \theta(f_0)$	0.364 < 1.58	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

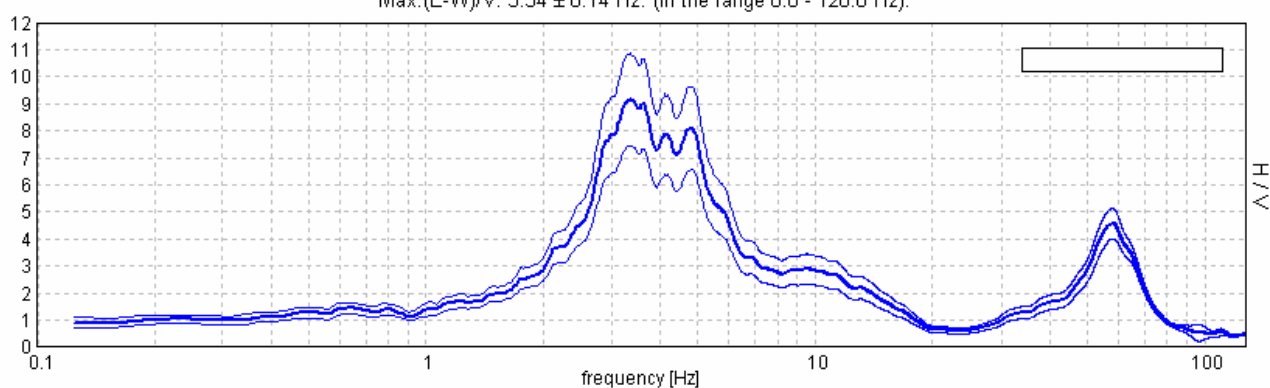
CAVALLETTO, 16

Start recording: 02/07/09 16:36:41 End recording: 02/07/09 17:04:42
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

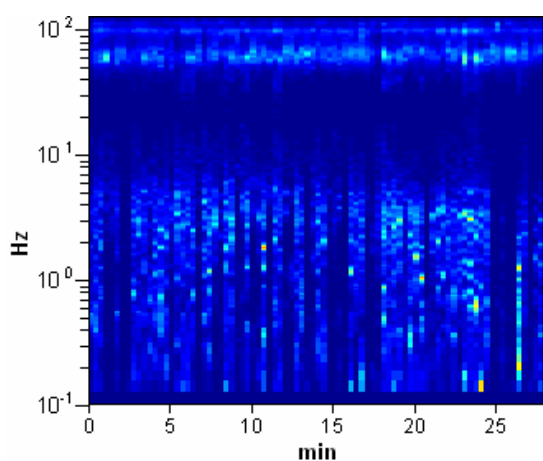
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

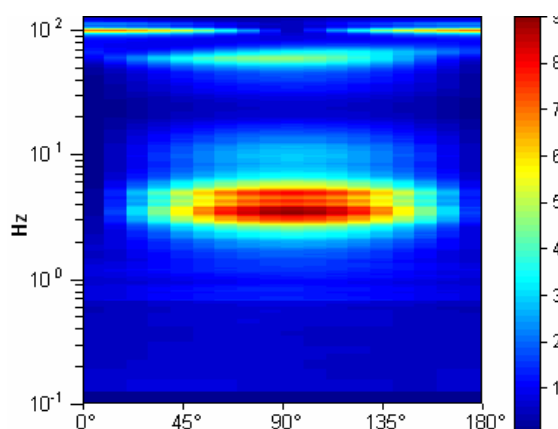
Max. (E-W)/V: 3.34 ± 0.14 Hz. (In the range 0.0 - 128.0 Hz).



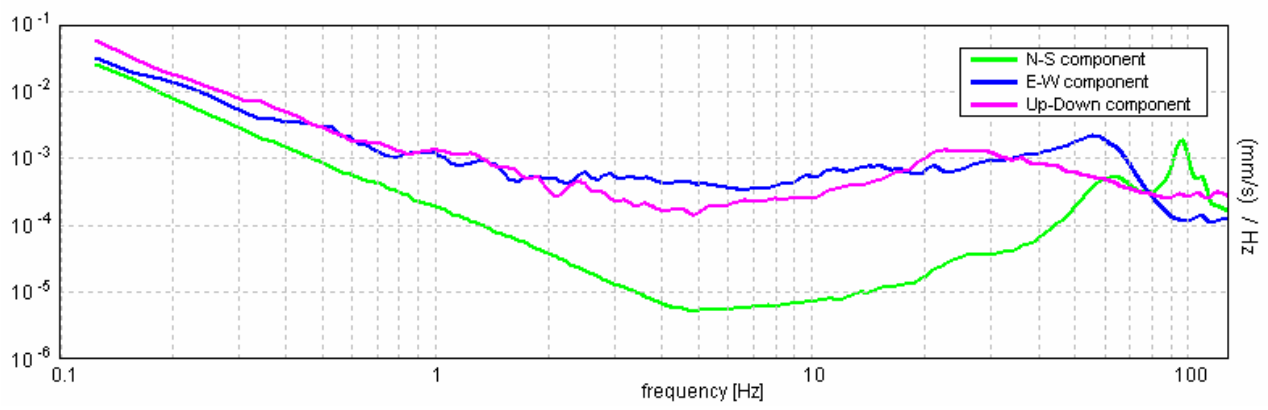
H/V TIME HISTORY



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 59.16 ± 1.98 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$59.16 > 0.50$	OK	
$n_c(f_0) > 200$	$99382.5 > 200$	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 2840 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	51.063 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	76.406 Hz	OK	
$A_0 > 2$	$2.18 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01673 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.98986 < 2.95781$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.0865 < 1.58$	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

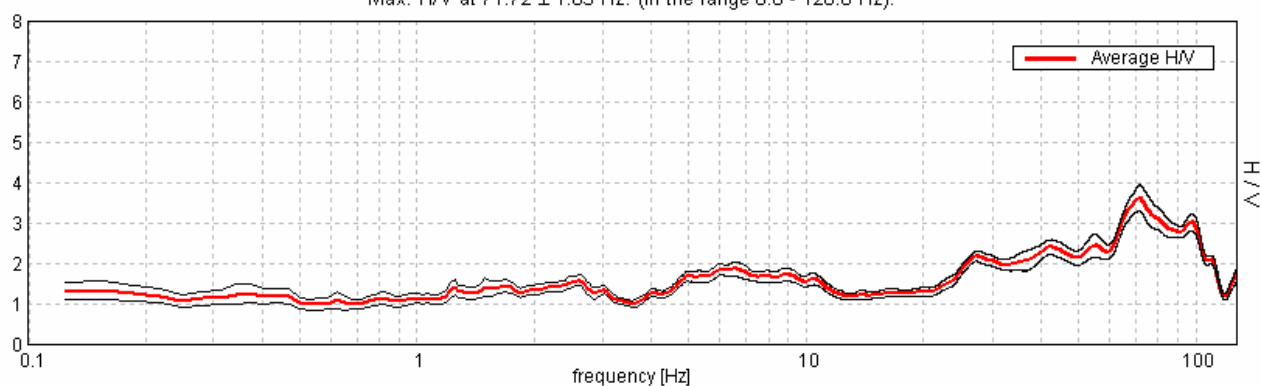
CAVALLETTO, 18

Start recording: 02/07/09 17:36:08 End recording: 02/07/09 18:04:09
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

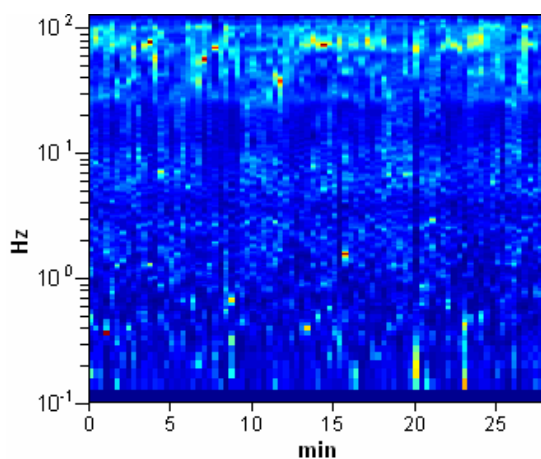
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

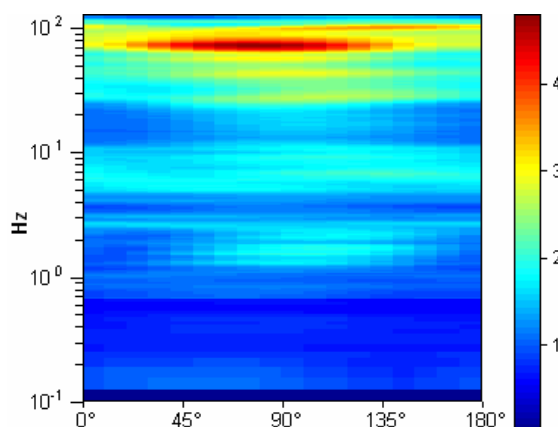
Max. H/V at 71.72 ± 1.85 Hz. (In the range 0.0 - 128.0 Hz).



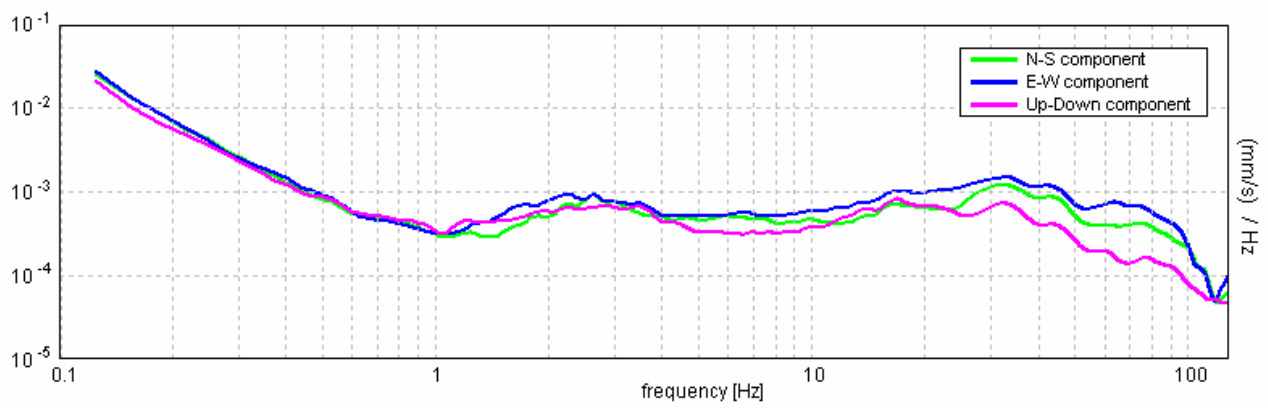
H/V TIME HISTORY



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 71.72 ± 1.85 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$71.72 > 0.50$	OK	
$n_c(f_0) > 200$	$120487.5 > 200$	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 2950 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	24.813 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	113.031 Hz	OK	
$A_0 > 2$	$3.62 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01292 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.92657 < 3.58594$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1608 < 1.58$	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

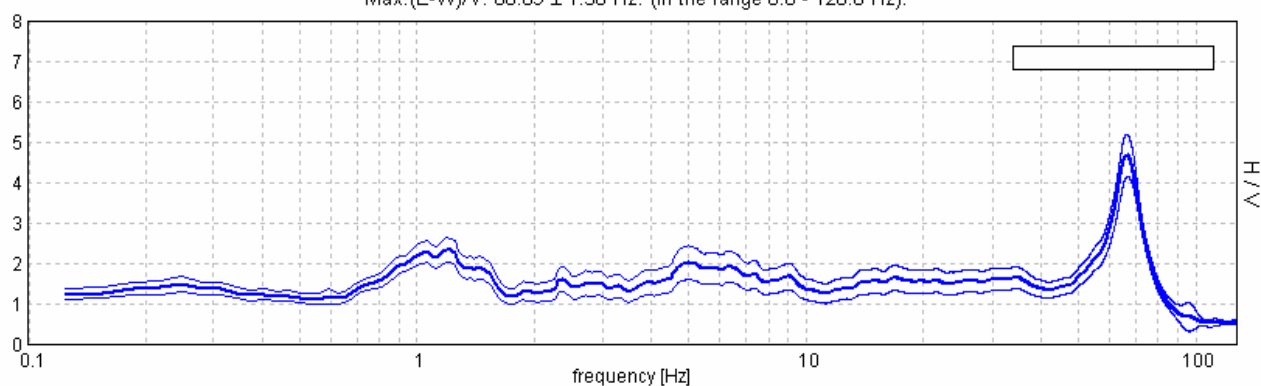
CAVALLETTO, 19

Start recording: 03/07/09 08:07:35 End recording: 03/07/09 08:35:36
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

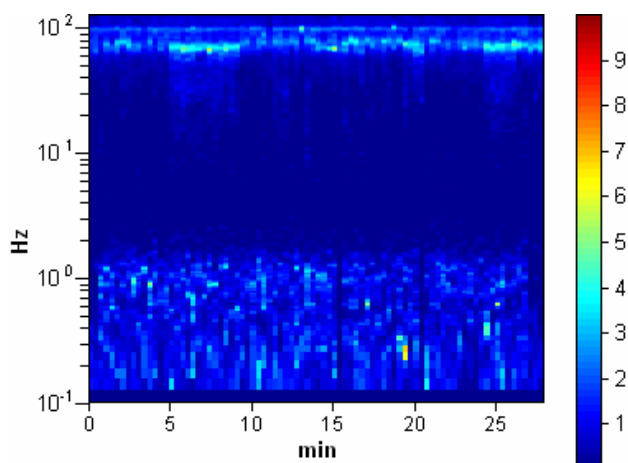
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

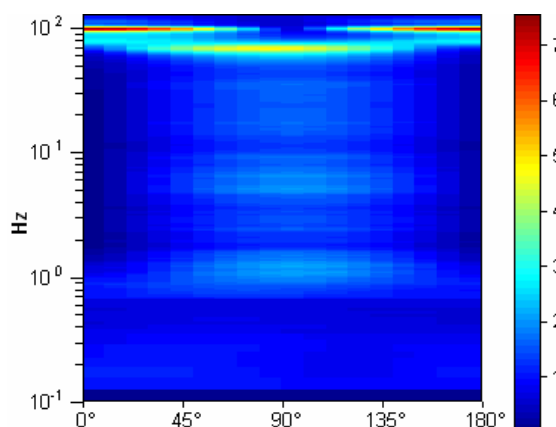
Max. (E-W)/V: 66.69 ± 1.56 Hz. (In the range 0.0 - 128.0 Hz).



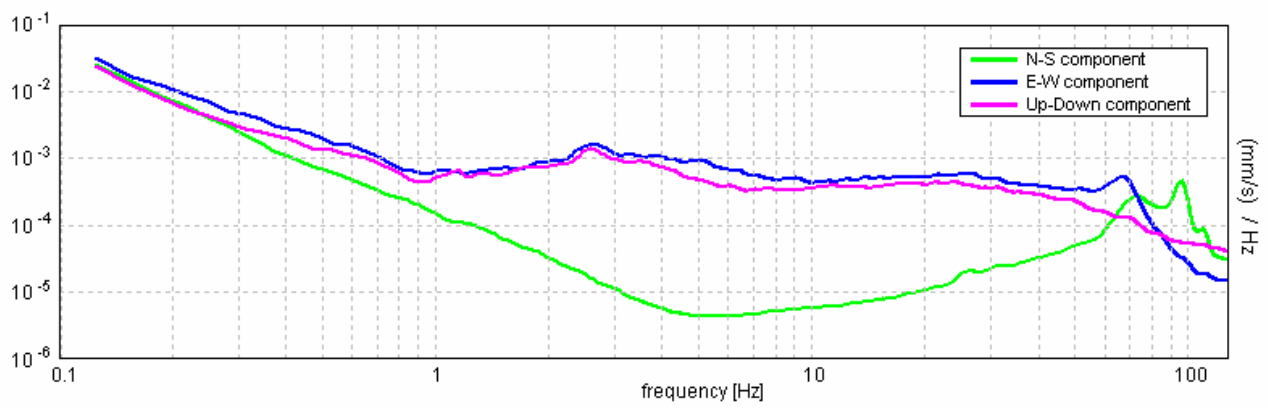
H/V TIME HISTORY



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 70.56 ± 1.34 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$70.56 > 0.50$	OK	
$n_c(f_0) > 200$	$118545.0 > 200$	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 2968 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	60.688 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	101.0 Hz	OK	
$A_0 > 2$	$2.69 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.00948 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.66908 < 3.52813$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.0911 < 1.58$	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

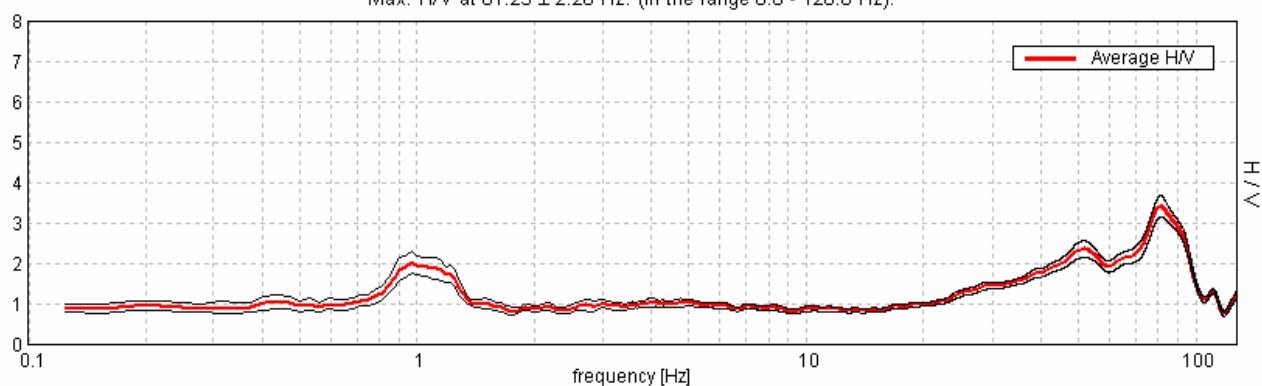
CAVALLETTO, 20

Start recording: 03/07/09 08:46:03 End recording: 03/07/09 09:14:04
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

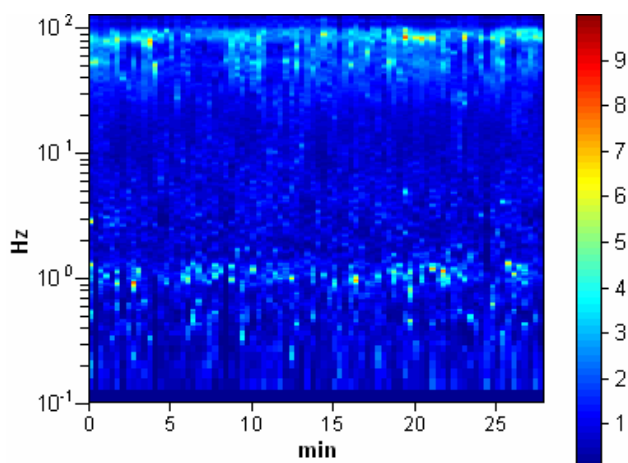
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

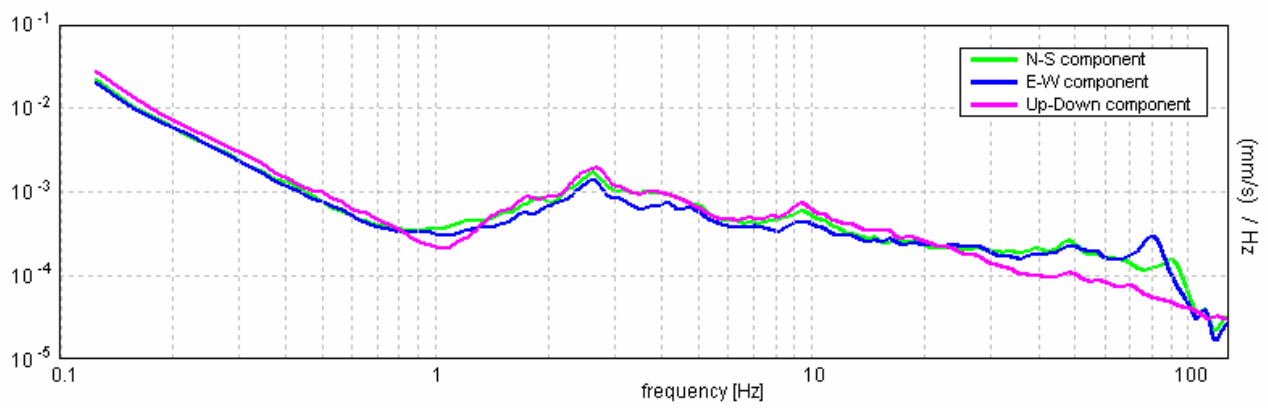
Max. H/V at 81.25 ± 2.26 Hz. (In the range 0.0 - 128.0 Hz).



H/V TIME HISTORY



SINGLE COMPONENT SPECTRA



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

Max. H/V at 81.25 ± 2.26 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$81.25 > 0.50$	OK	
$n_c(f_0) > 200$	$136500.0 > 200$	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 2797 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	37.656 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	98.781 Hz	OK	
$A_0 > 2$	$3.43 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.01388 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$1.12802 < 4.0625$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1318 < 1.58$	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

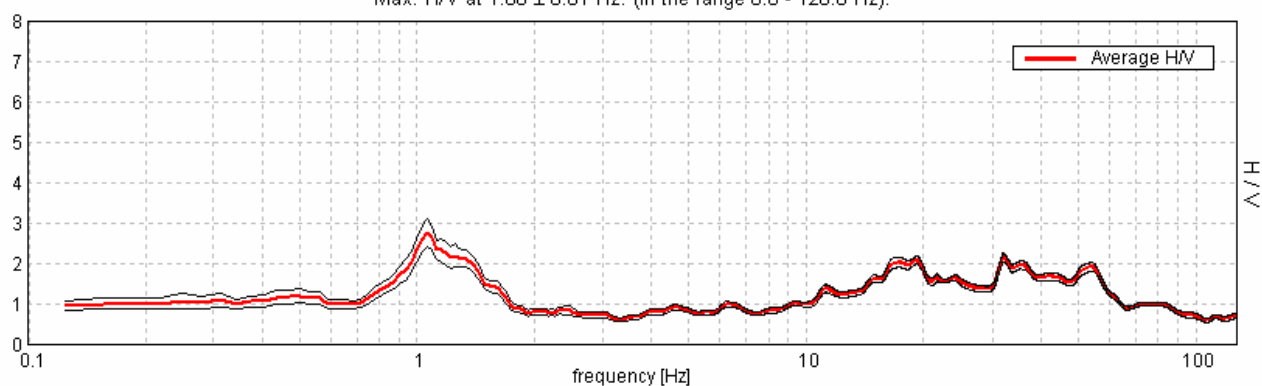
CAVALLETTO, 21

Start recording: 03/07/09 09:41:04 End recording: 03/07/09 10:09:04
Channel labels: NORTH SOUTH; EAST WEST ; UP DOWN
GPS data not available

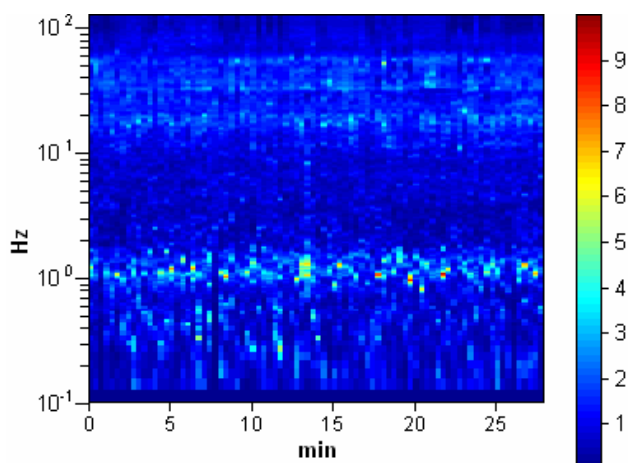
Trace length: 0h28'00". Analysis performed on the entire trace.
Sampling frequency: 256 Hz
Window size: 20 s
Smoothing window: Triangular window
Smoothing: 5%

HORIZONTAL TO VERTICAL SPECTRAL RATIO

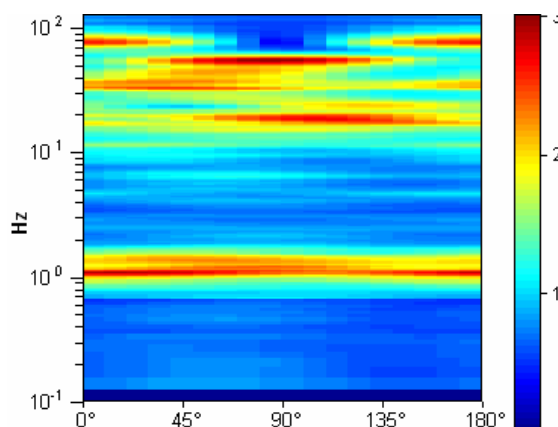
Max. H/V at 1.06 ± 0.01 Hz. (In the range 0.0 - 128.0 Hz).



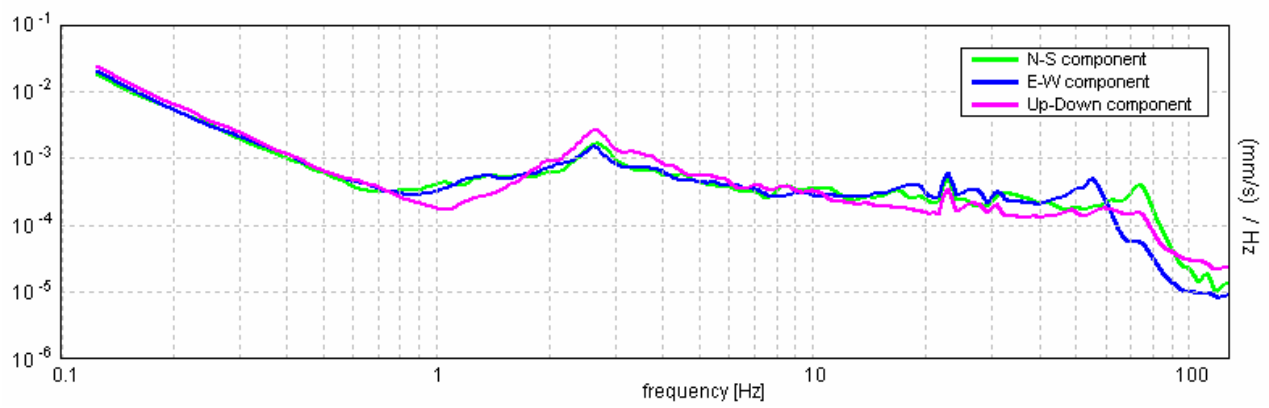
H/V TIME HISTORY



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 1.06 ± 0.01 Hz. (in the range 0.0 - 128.0 Hz).

Criteria for a reliable HVSR curve

[All 3 should be fulfilled]

$f_0 > 10 / L_w$	$1.06 > 0.50$	OK	
$n_c(f_0) > 200$	$1785.0 > 200$	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 52 times	OK	

Criteria for a clear HVSR peak

[At least 5 out of 6 should be fulfilled]

Exists f^- in $[f_0/4, f_0]$ $A_{H/V}(f^-) < A_0 / 2$	0.813 Hz	OK	
Exists f^+ in $[f_0, 4f_0]$ $A_{H/V}(f^+) < A_0 / 2$	1.656 Hz	OK	
$A_0 > 2$	$2.78 > 2$	OK	
$f_{\text{peak}}[A_{H/V}(f) \pm \sigma_A(f)] = f_0 \pm 5\%$	$ 0.0026 < 0.05$	OK	
$\sigma_f < \varepsilon(f_0)$	$0.00276 < 0.10625$	OK	
$\sigma_A(f_0) < \theta(f_0)$	$0.1701 < 1.78$	OK	

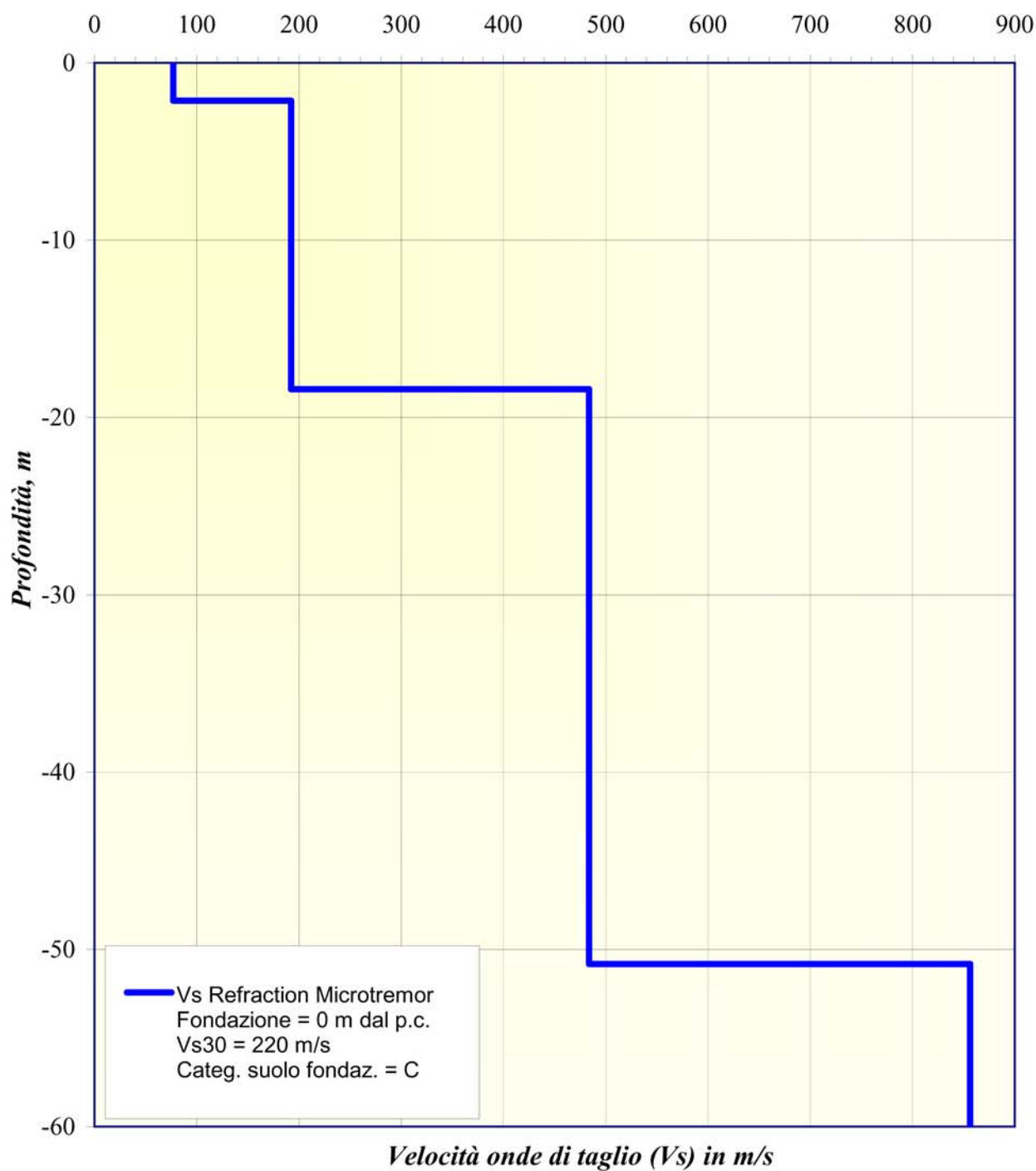
L_w	window length
n_w	number of windows used in the analysis
$n_c = L_w n_w f_0$	number of significant cycles
f	current frequency
f_0	H/V peak frequency
σ_f	standard deviation of H/V peak frequency
$\varepsilon(f_0)$	threshold value for the stability condition $\sigma_f < \varepsilon(f_0)$
A_0	H/V peak 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

Valle 13

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

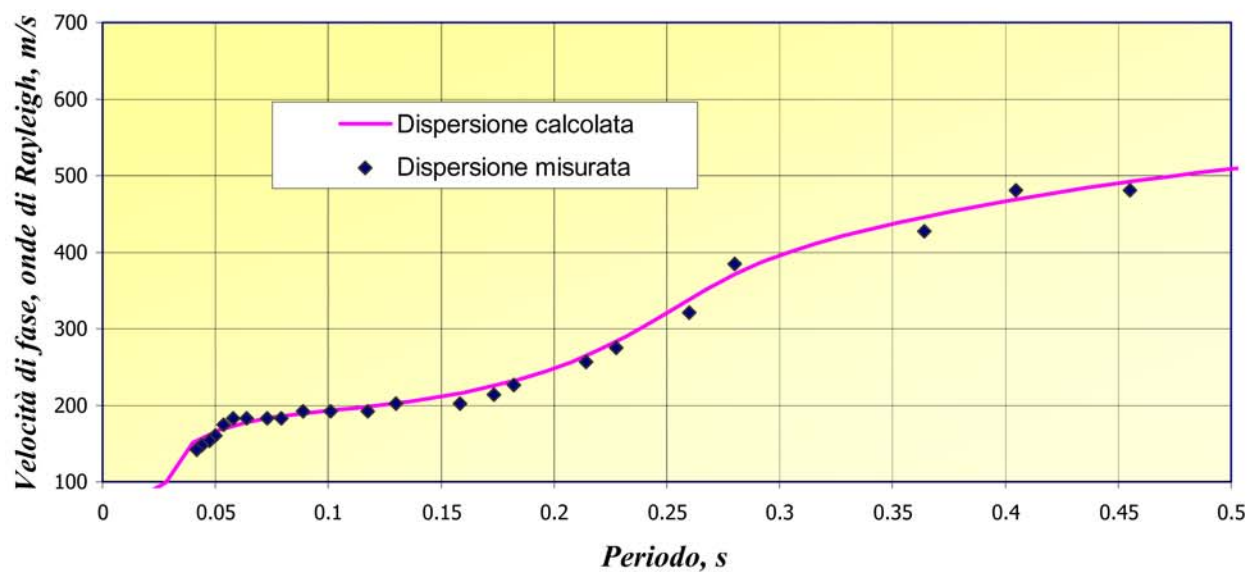
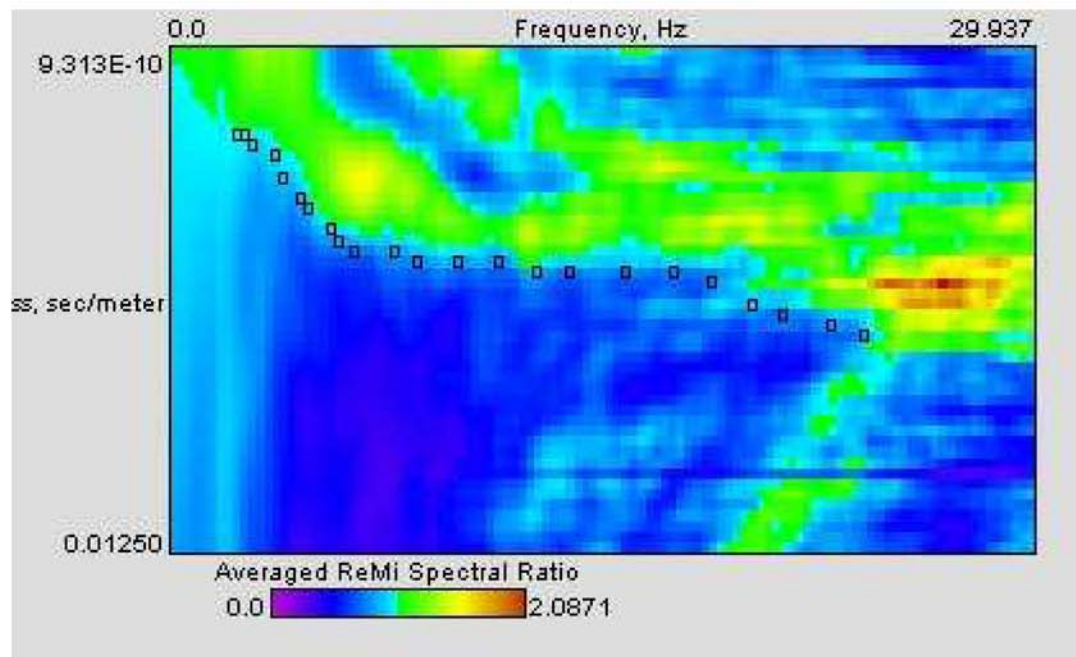
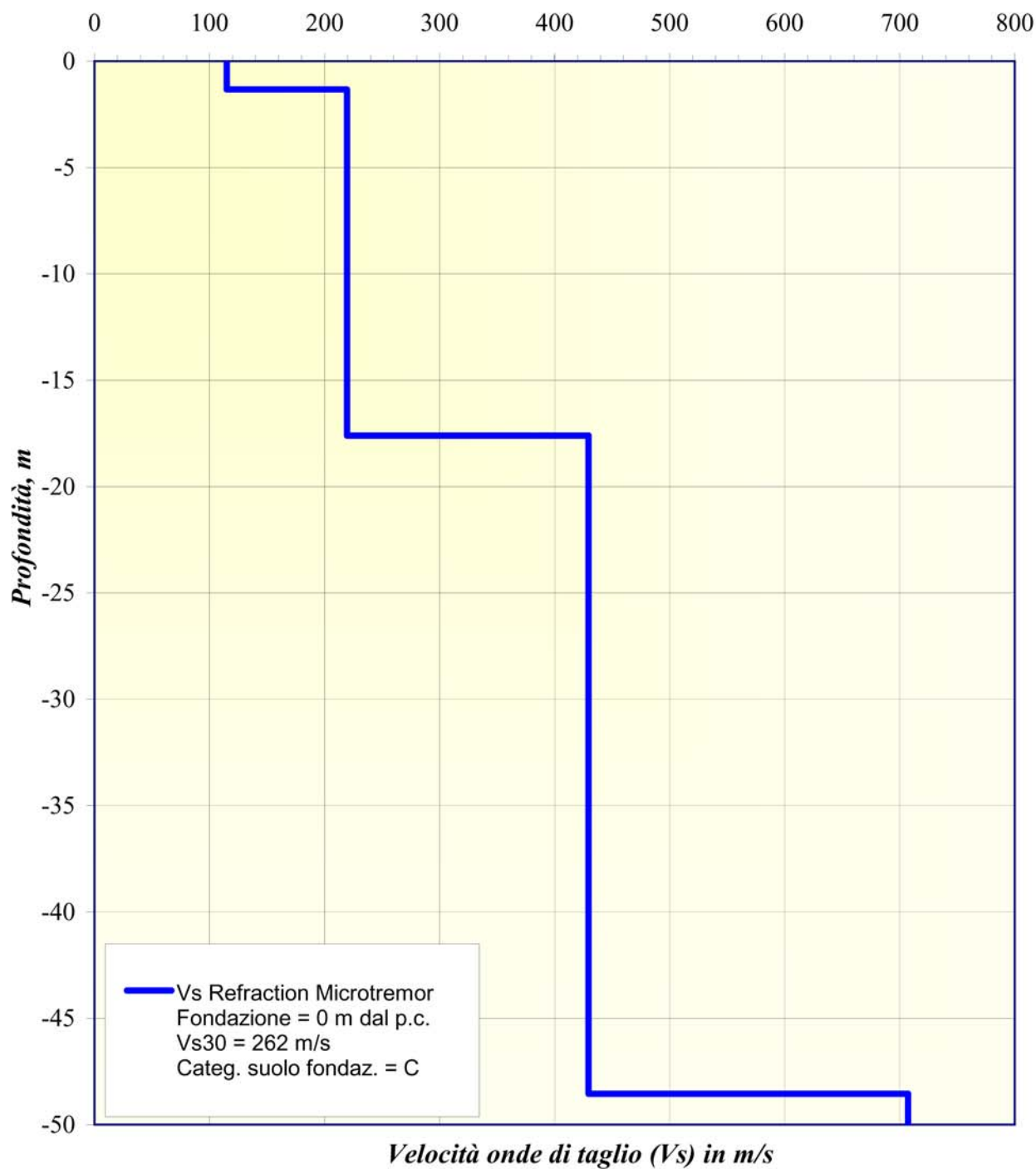


grafico slowness/frequenza



Valle 44

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

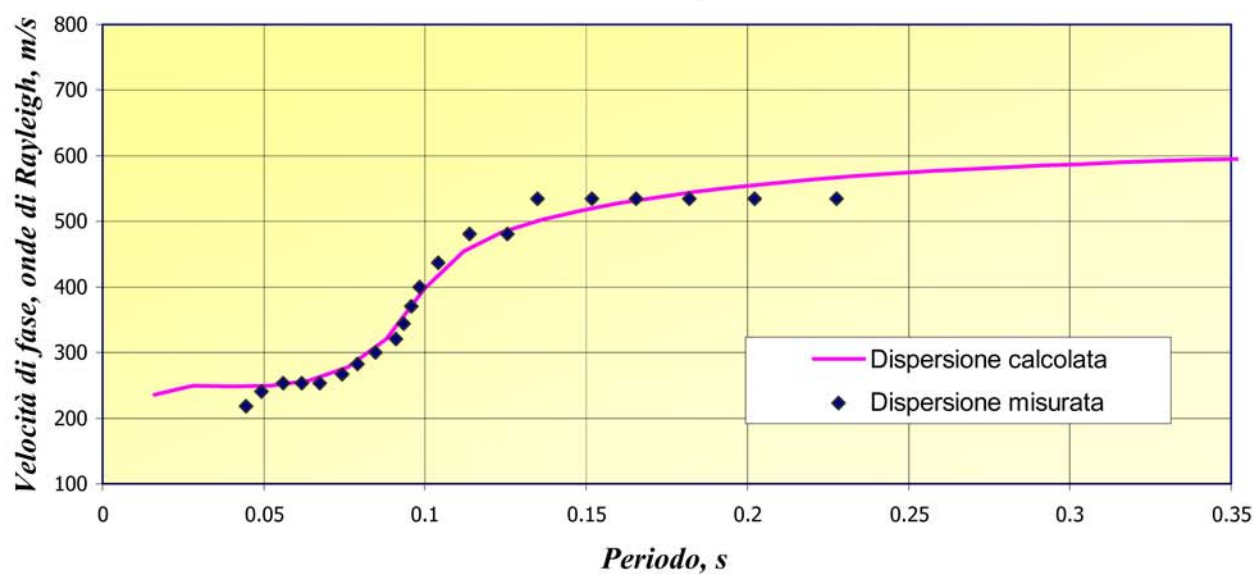
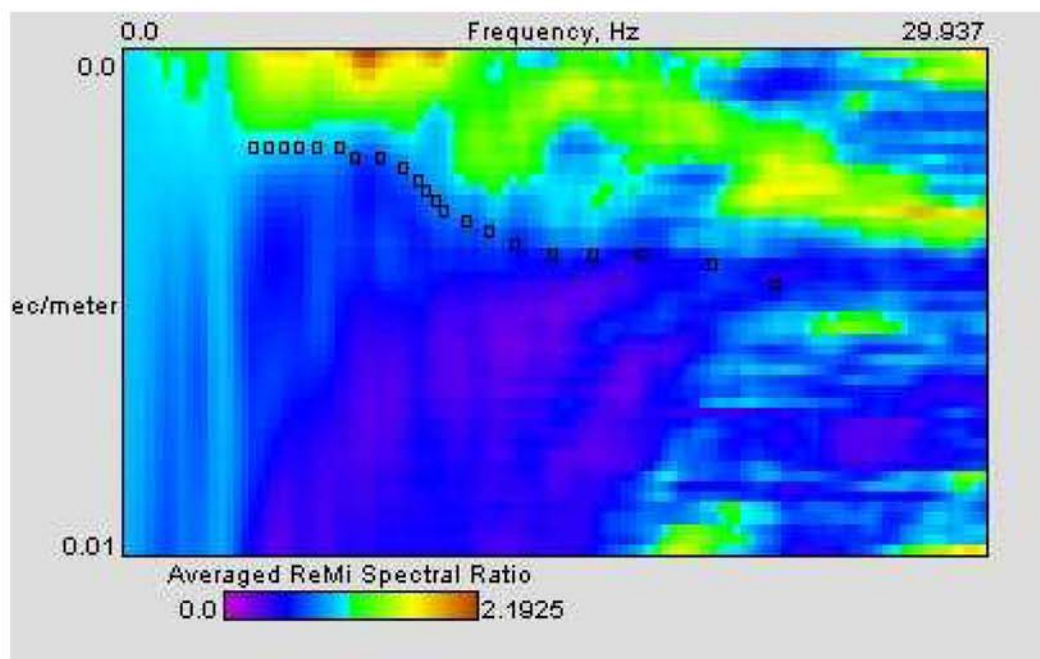
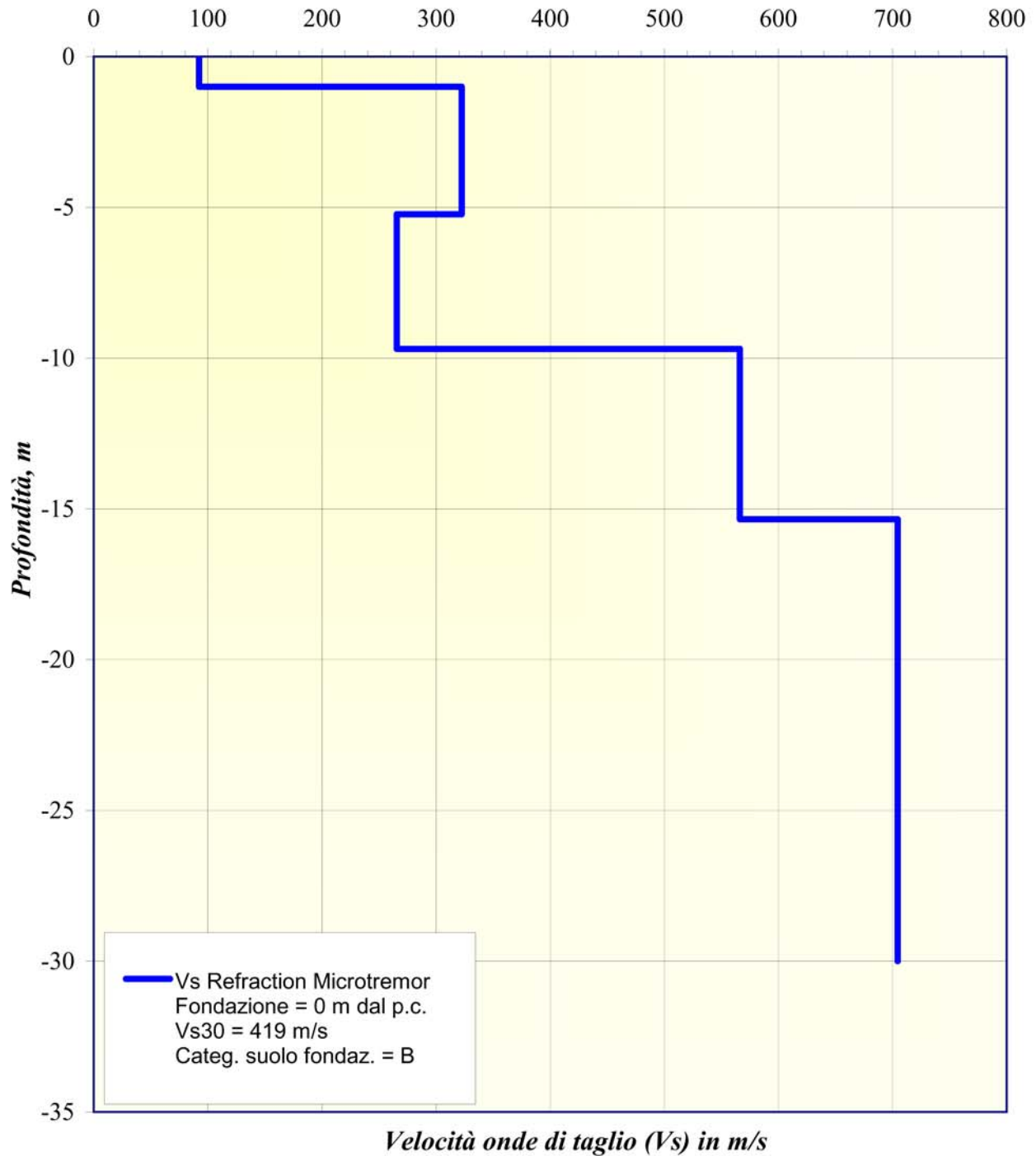


grafico slowness/frequenza



Valle 15

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

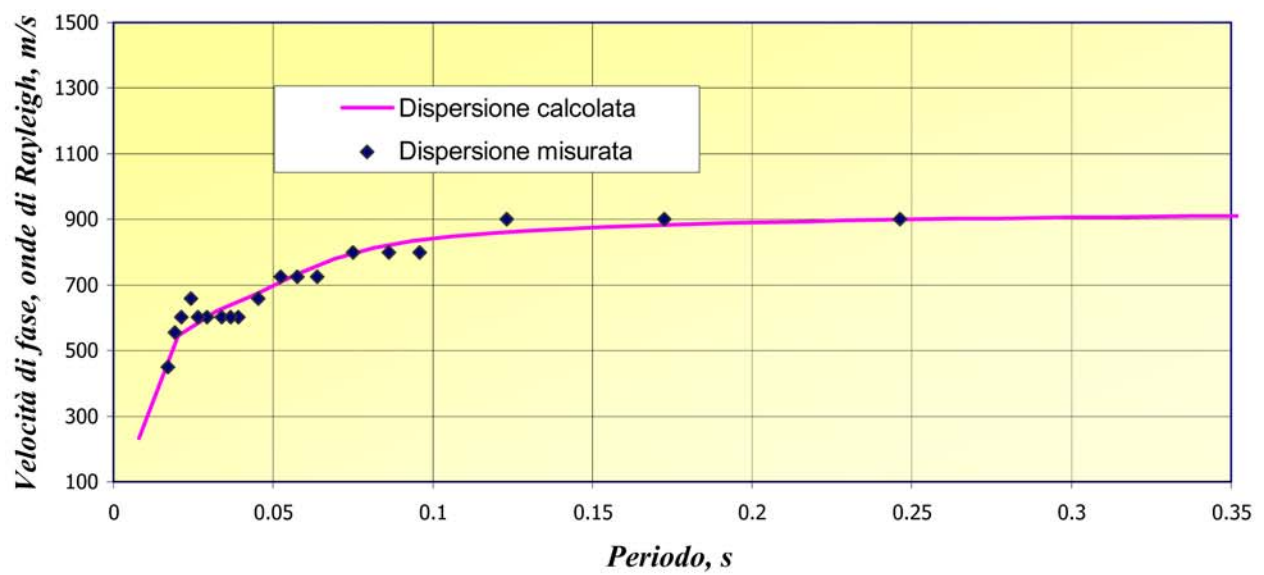
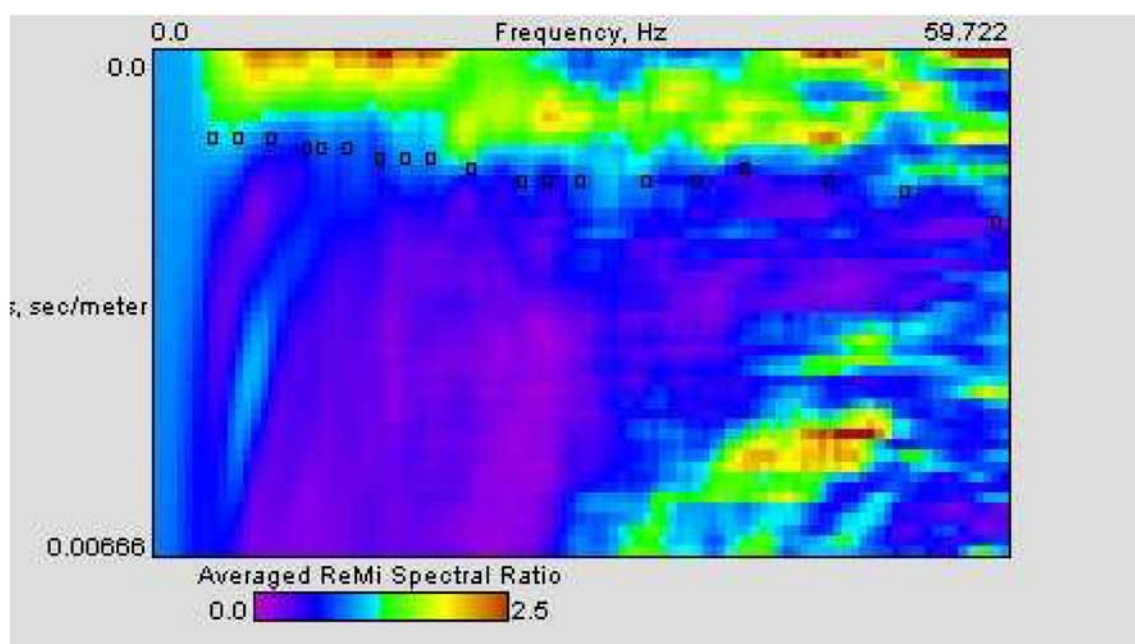
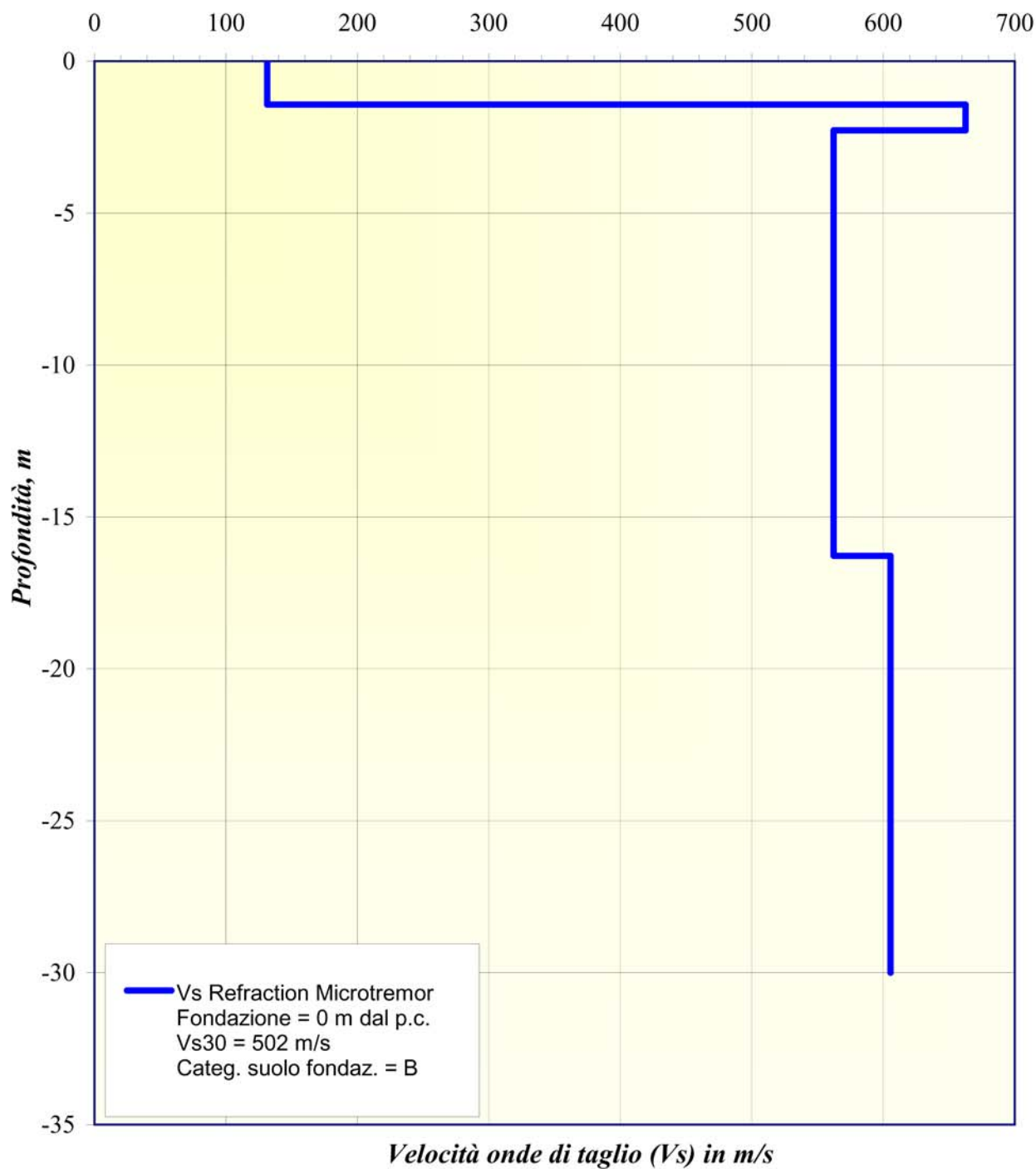


grafico slowness/frequenza



Valle 14

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

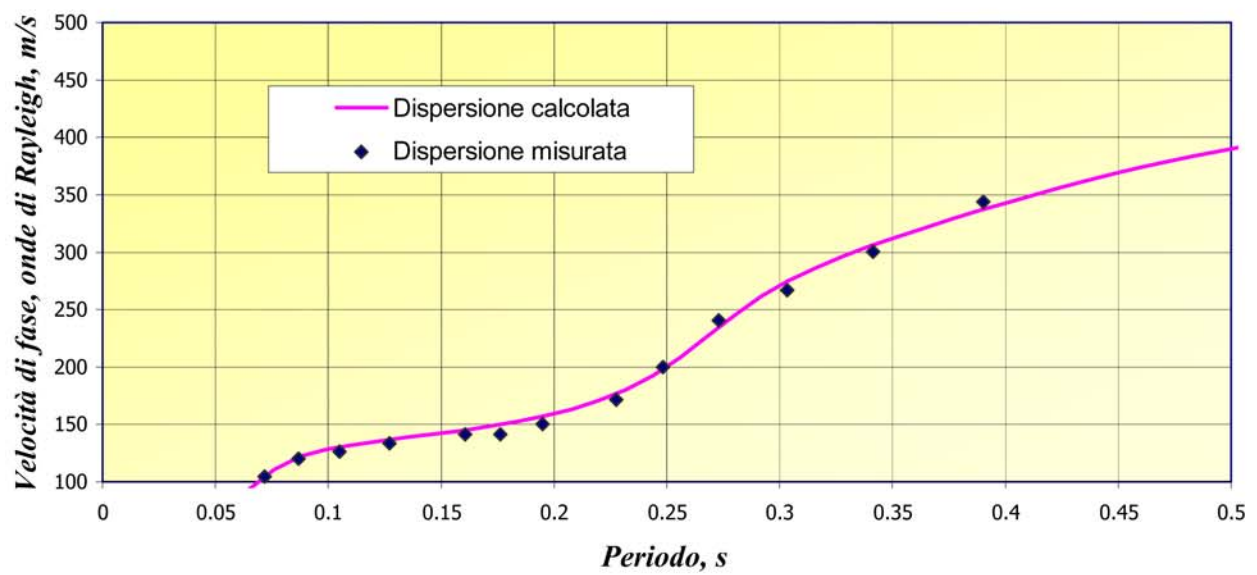
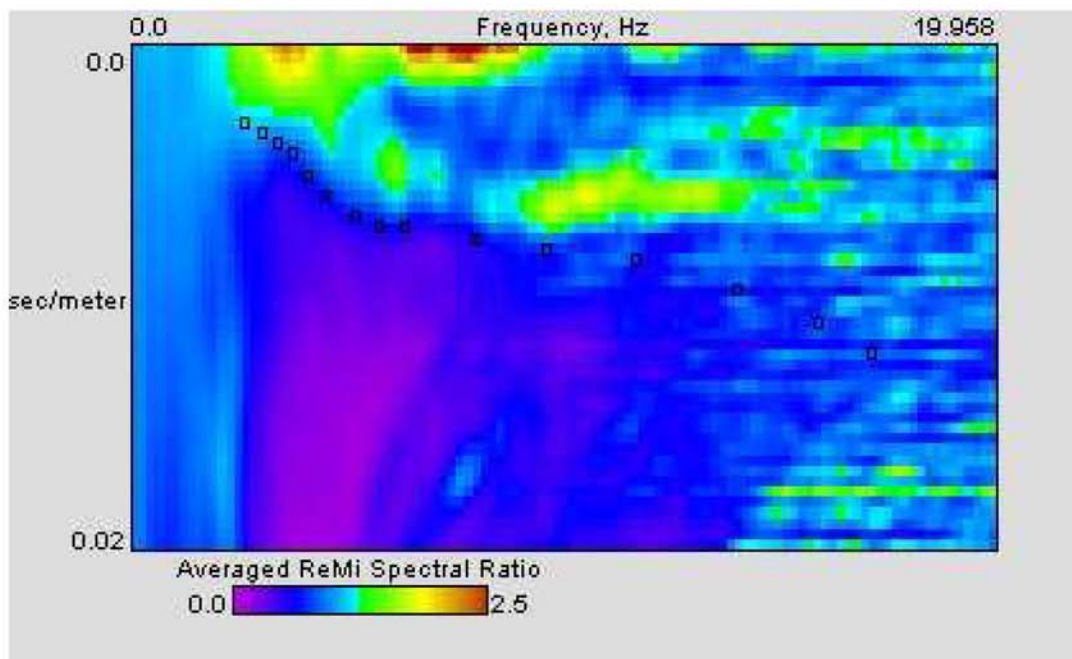
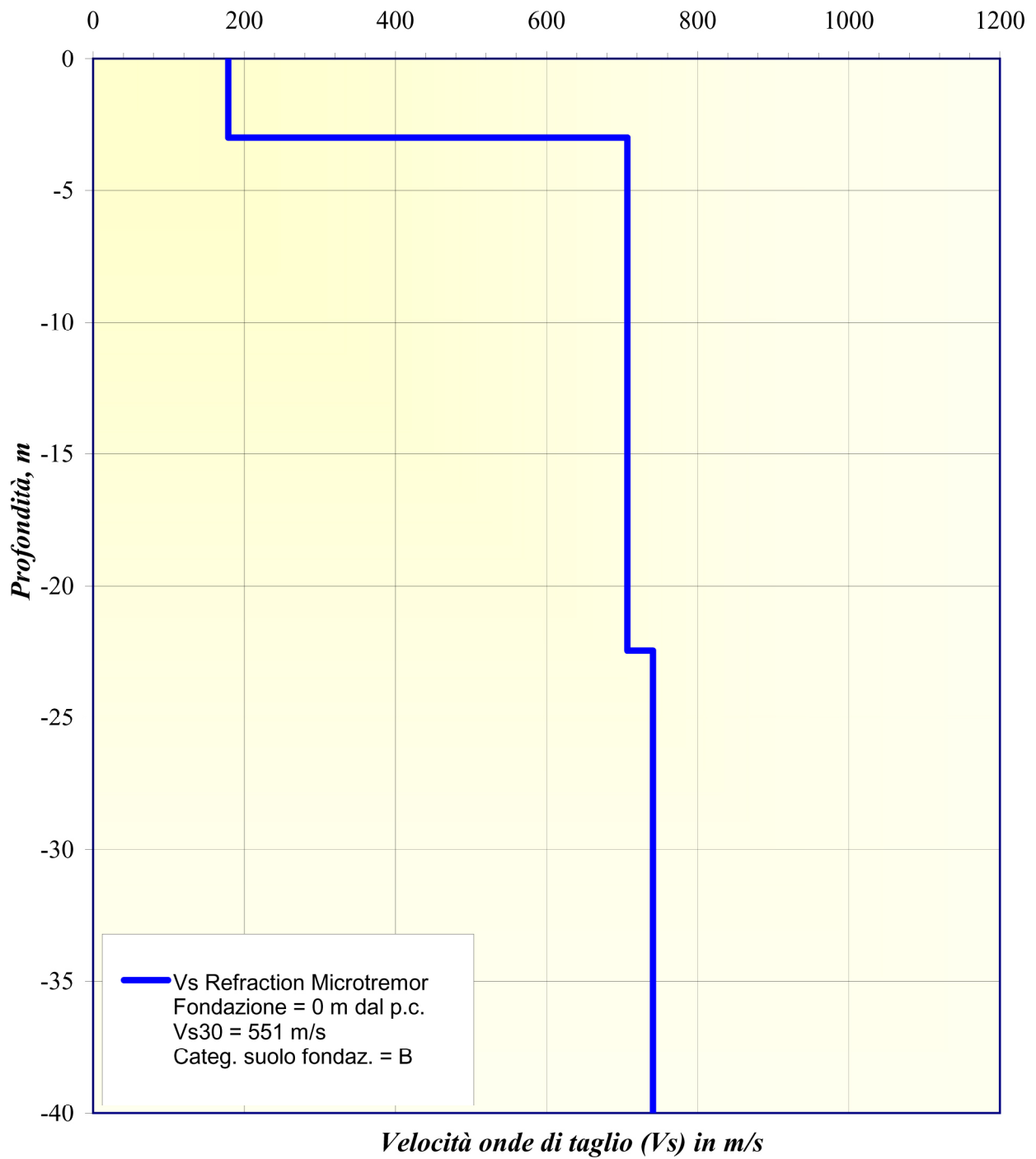


grafico slowness/frequenza



Cavalletto 16

Vertical Seismic Profile delle Vs
(calcolato con ReMi)



Curva di dispersione

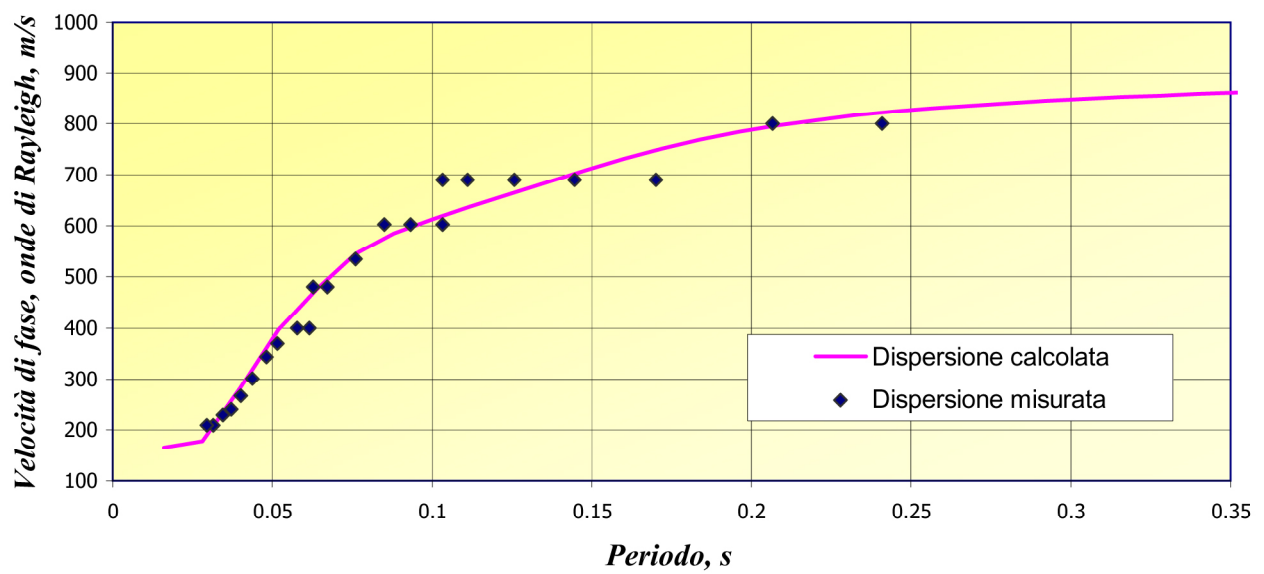
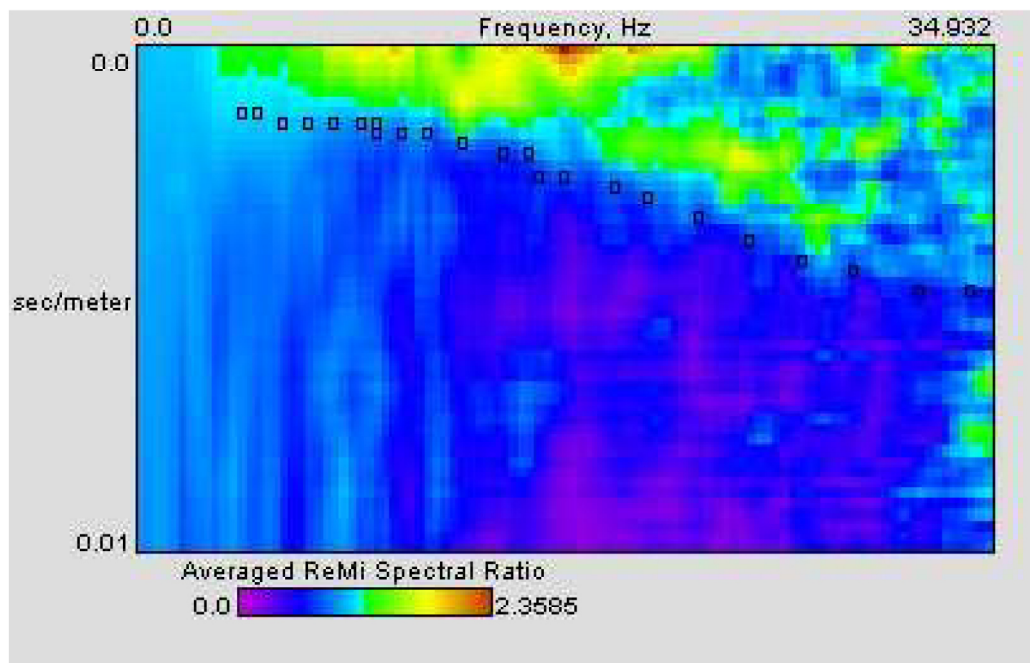
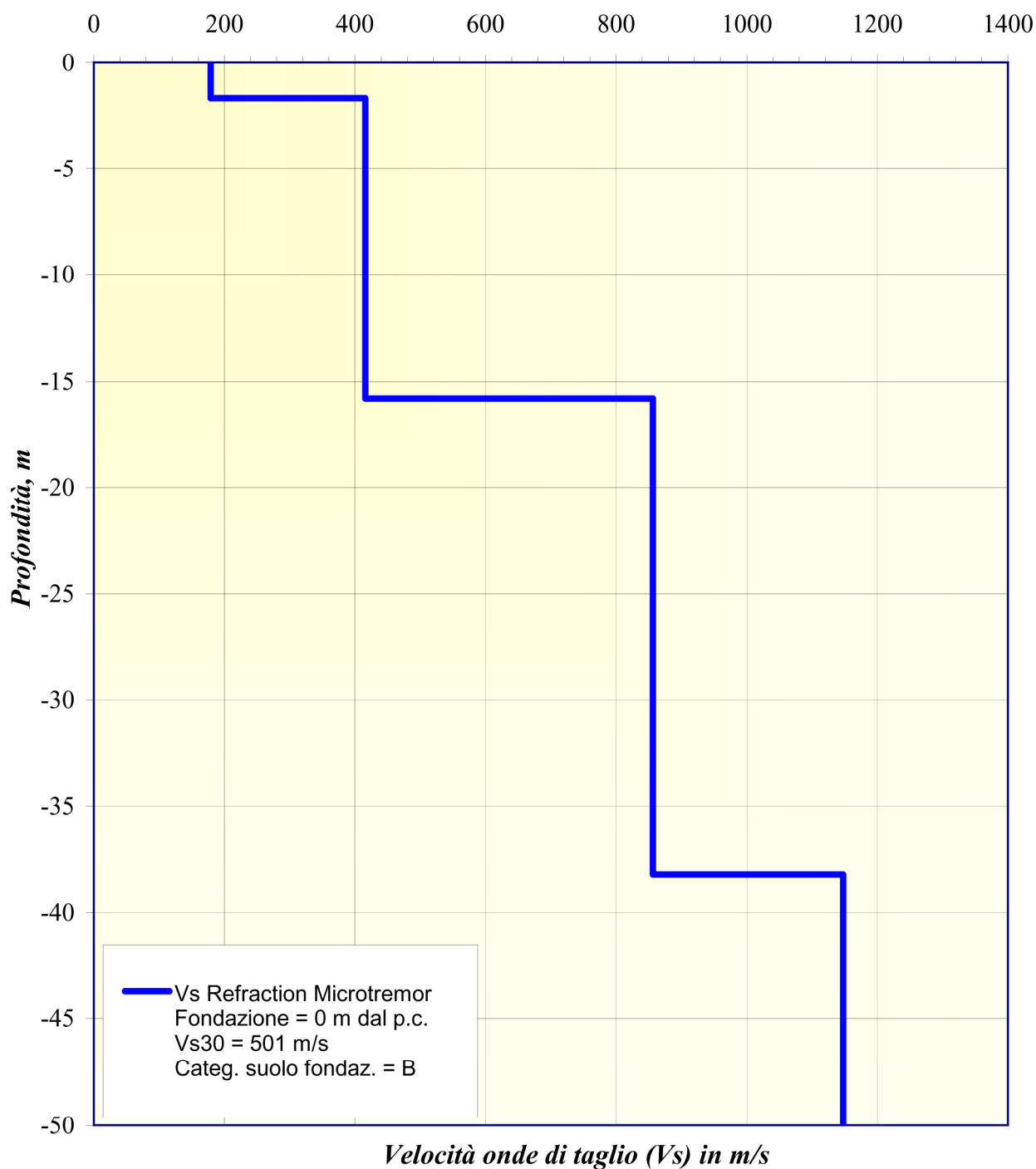


grafico slowness/frequenza



Cavalletto 17

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

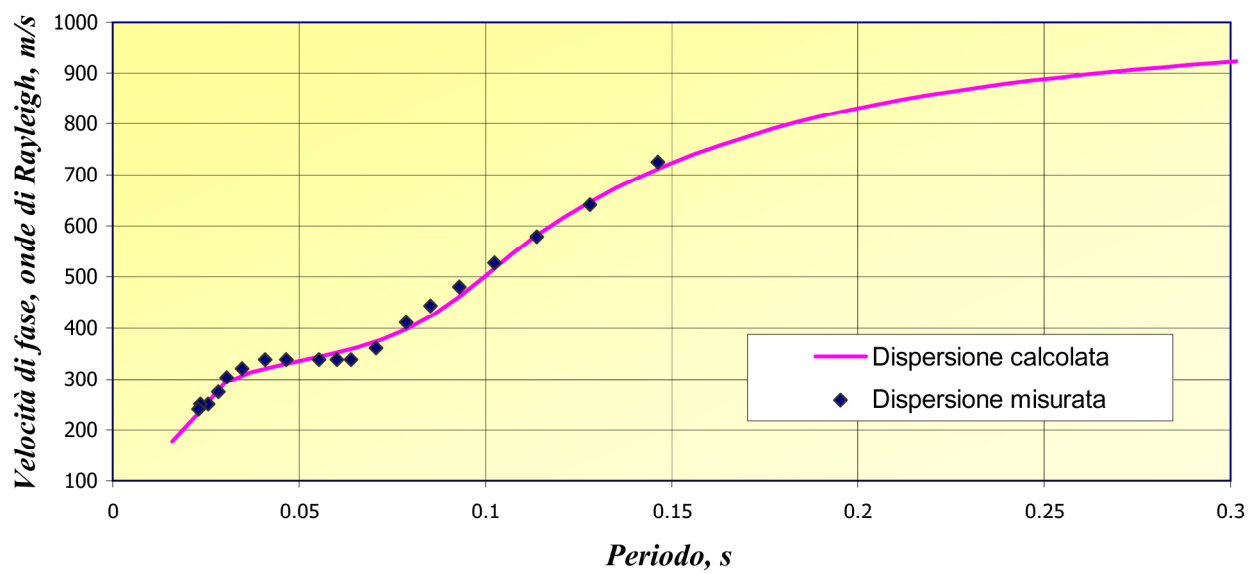
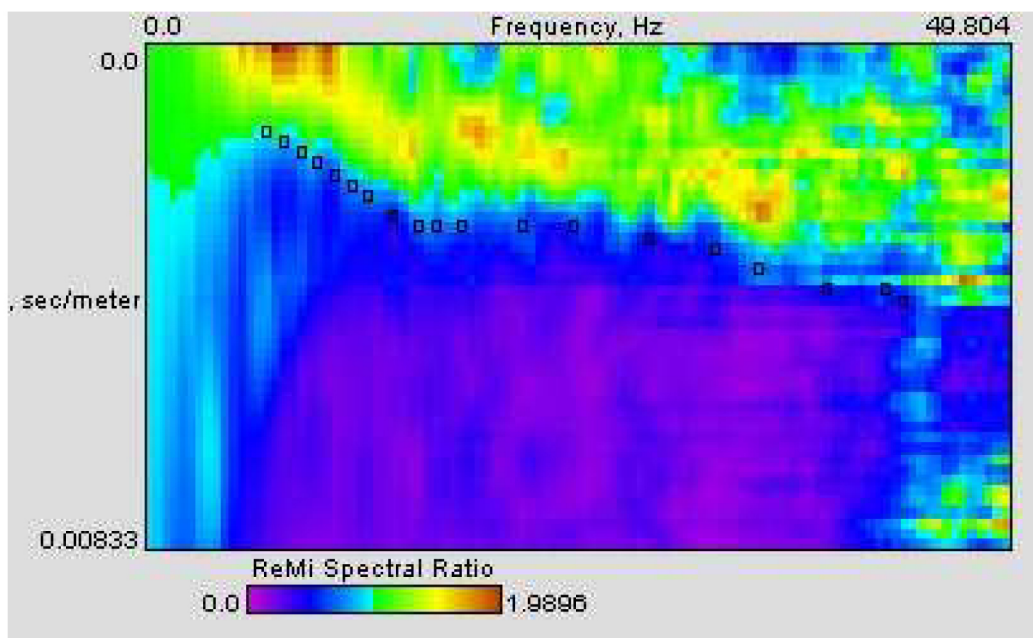
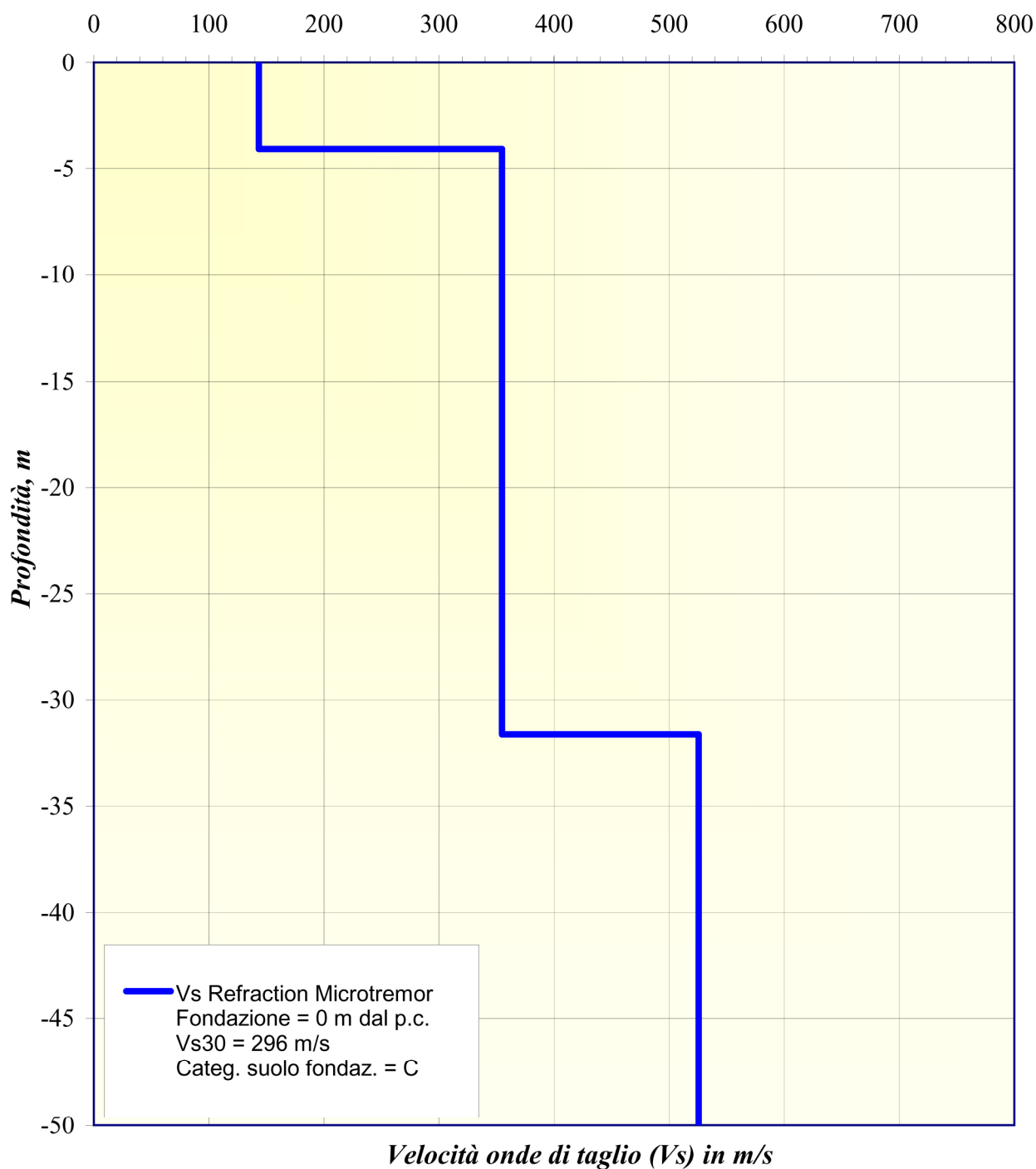


grafico slowness/frequenza



Cavalletto 18

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

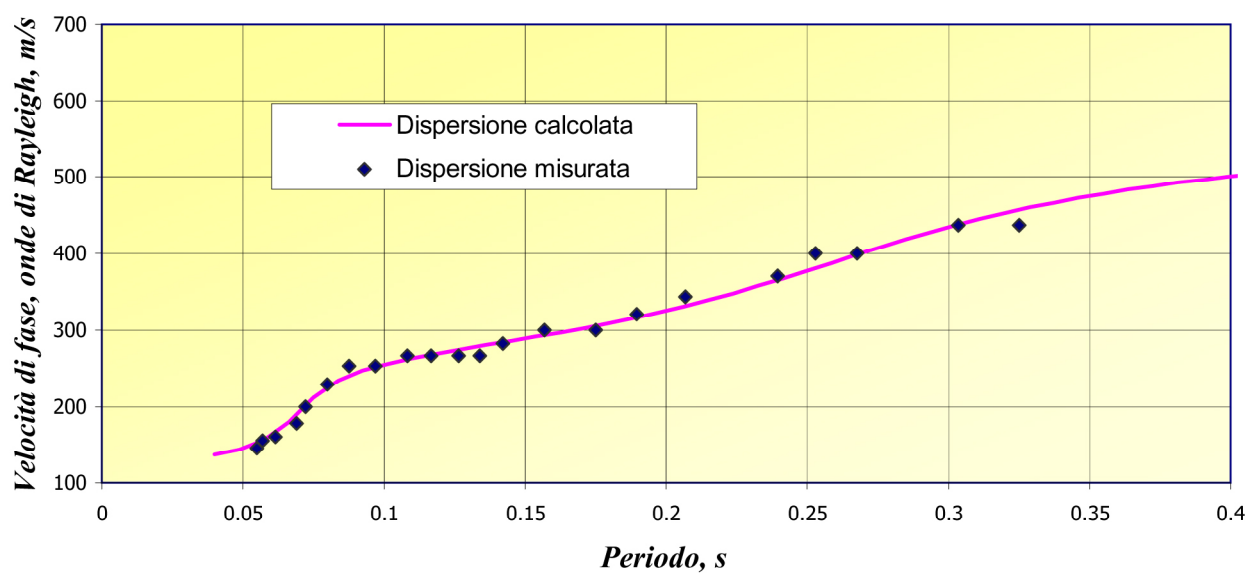
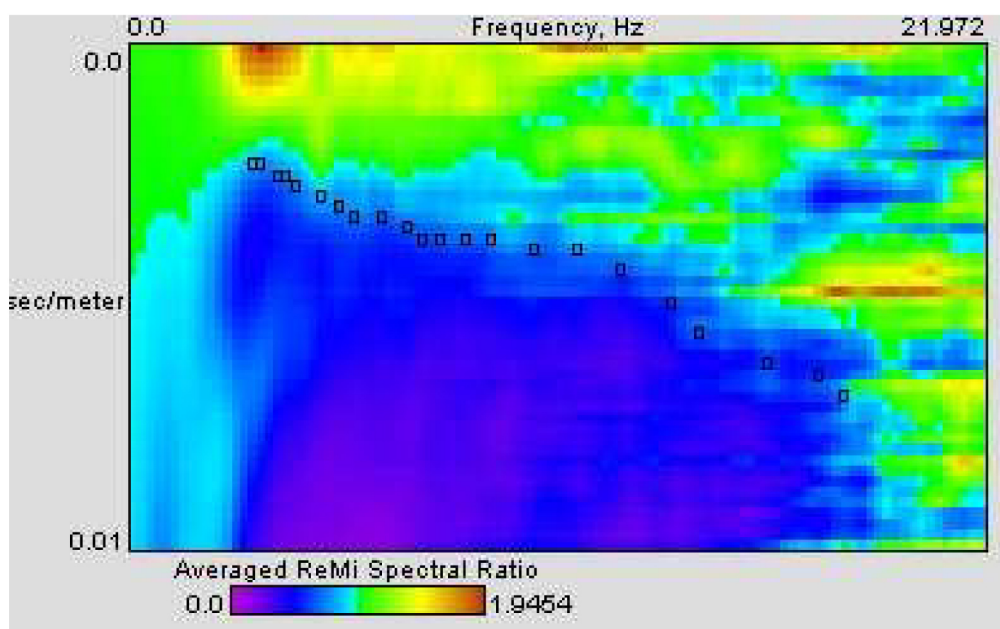
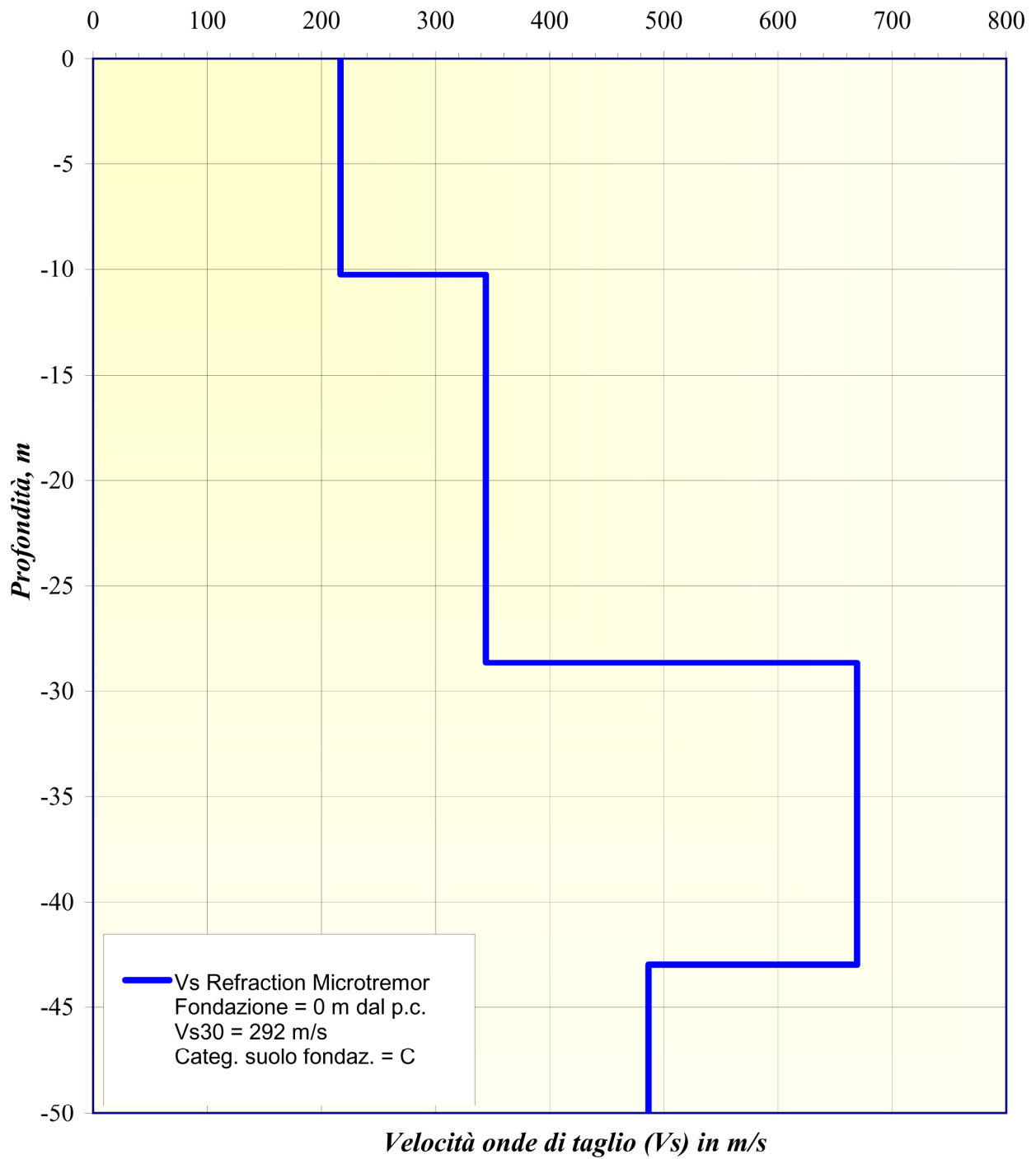


grafico slowness/frequenza



Cavalletto 19

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

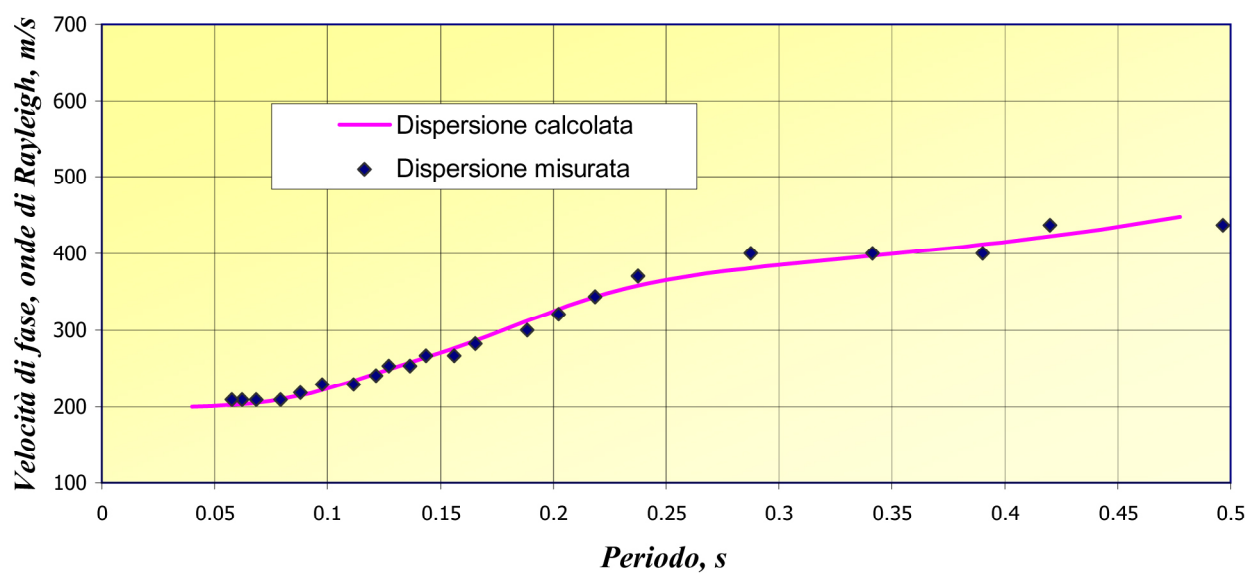
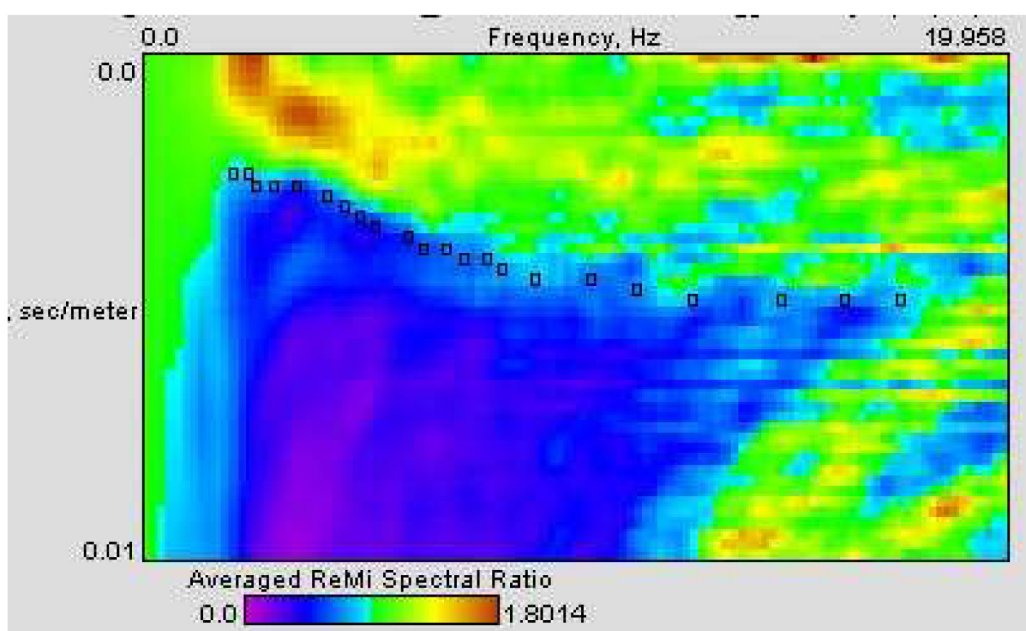
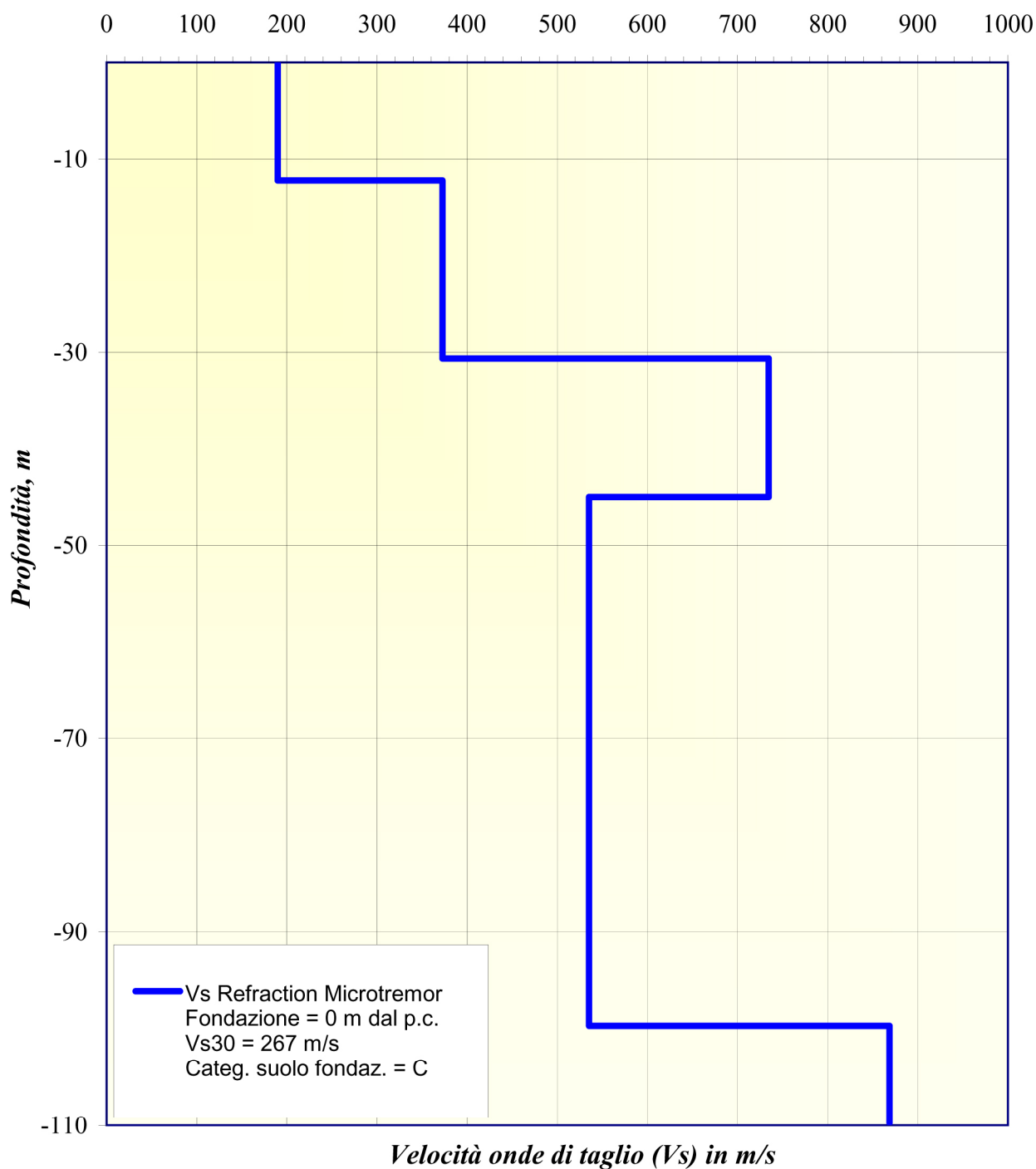


grafico slowness/frequenza



Cavalletto 20

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

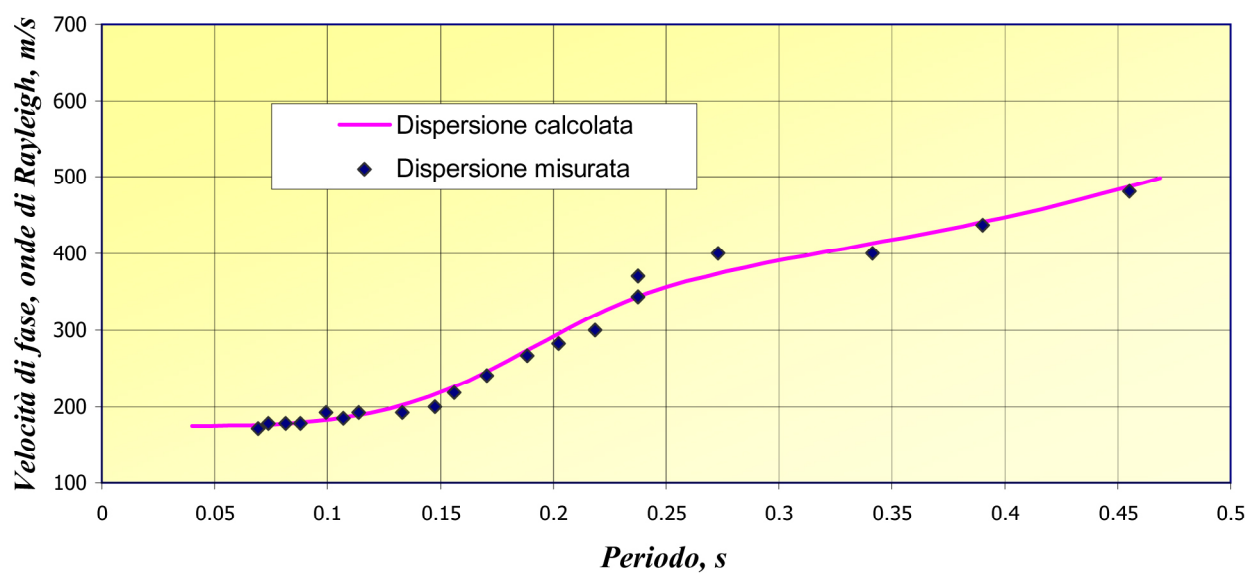
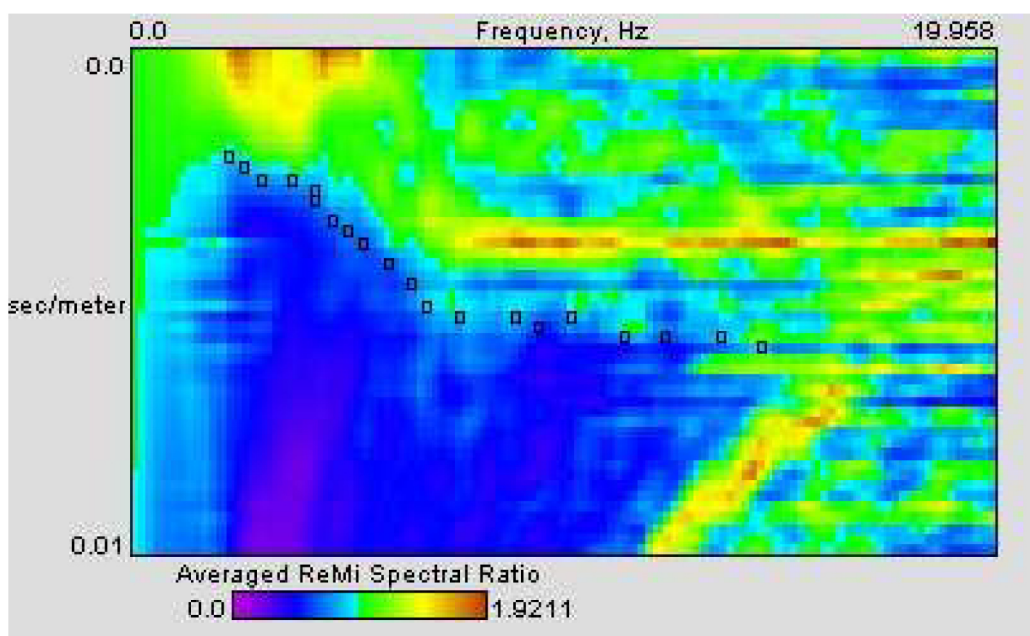
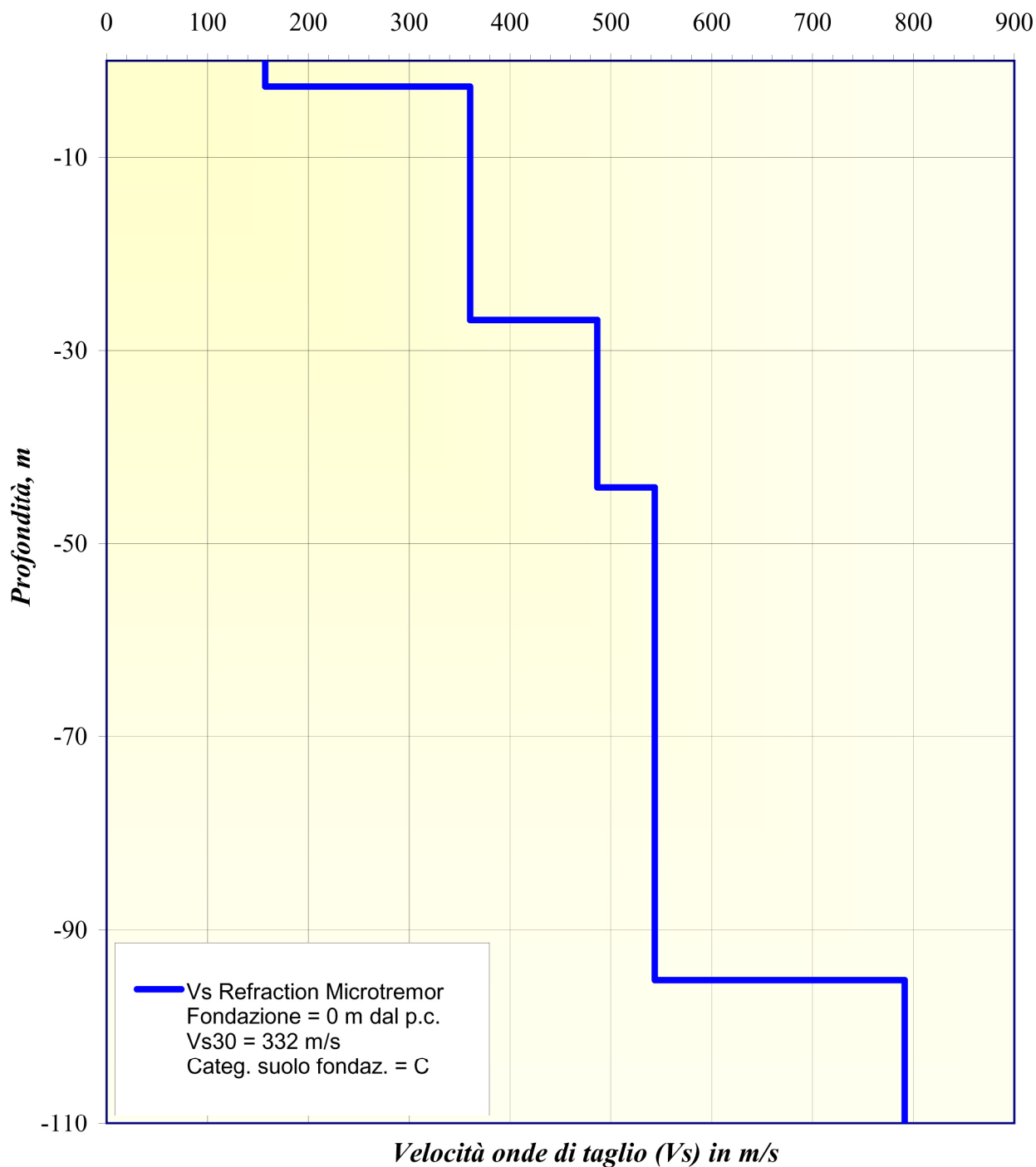


grafico slowness/frequenza



Cavalletto 21

*Vertical Seismic Profile delle Vs
(calcolato con ReMi)*



Curva di dispersione

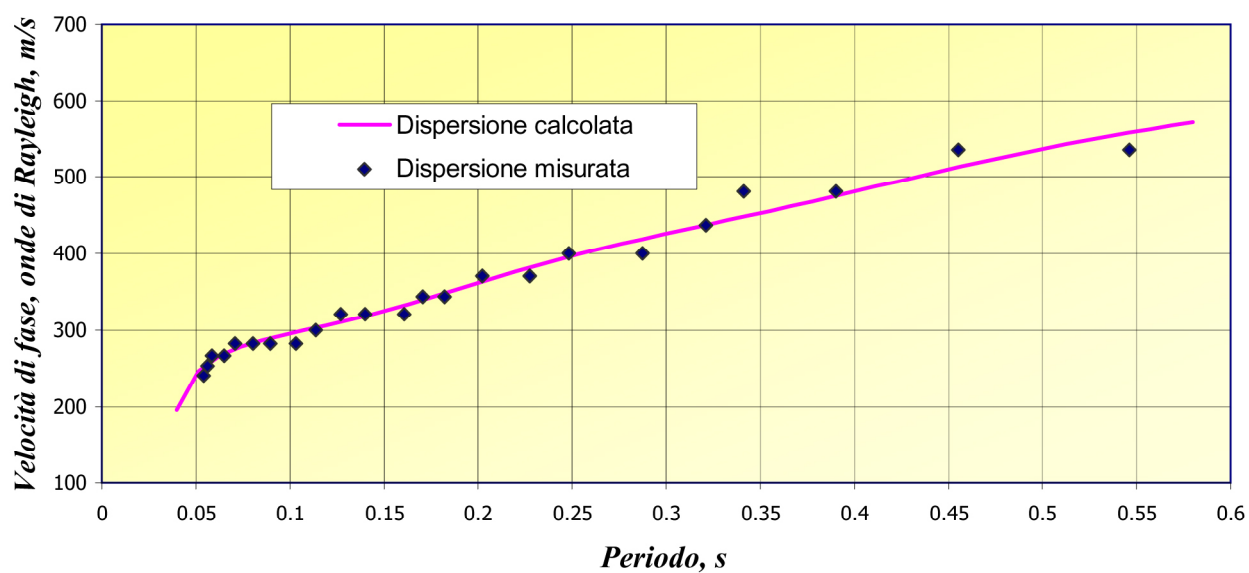


grafico slowness/frequenza

