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Project Title: Site Effects Assessment Using Ambient Excitations

Supported by: The European Commission – Research General Directorate

Project No: EVG1-CT-2000-00026 SESAME

Report title: Optimum deployment strategy for array measurements,
University of Potsdam, Germany,
WP05: Instrumental layout for array measurements

Deliverable No.: D07.05

APPENDIX 3

Preliminary results of array analysis for the determination of dispersion curves from ambient vibration data - All test sites

This Appendix contains the complete overview of the preliminary array analysis performed for all individual test sites. We show here the results obtained from the FK-technique in the same manner as described in the Report on the optimum deployment strategy for array measurements in deliverable D07.05, section 3. For sites, where geotechnical information has been available we displayed additionally the theoretical dispersion curves. Plots of the shear velocity models are shown in D07.05 - Appendix 3 - Figure 29 and D07.05 - Appendix 3 - Figure 30.

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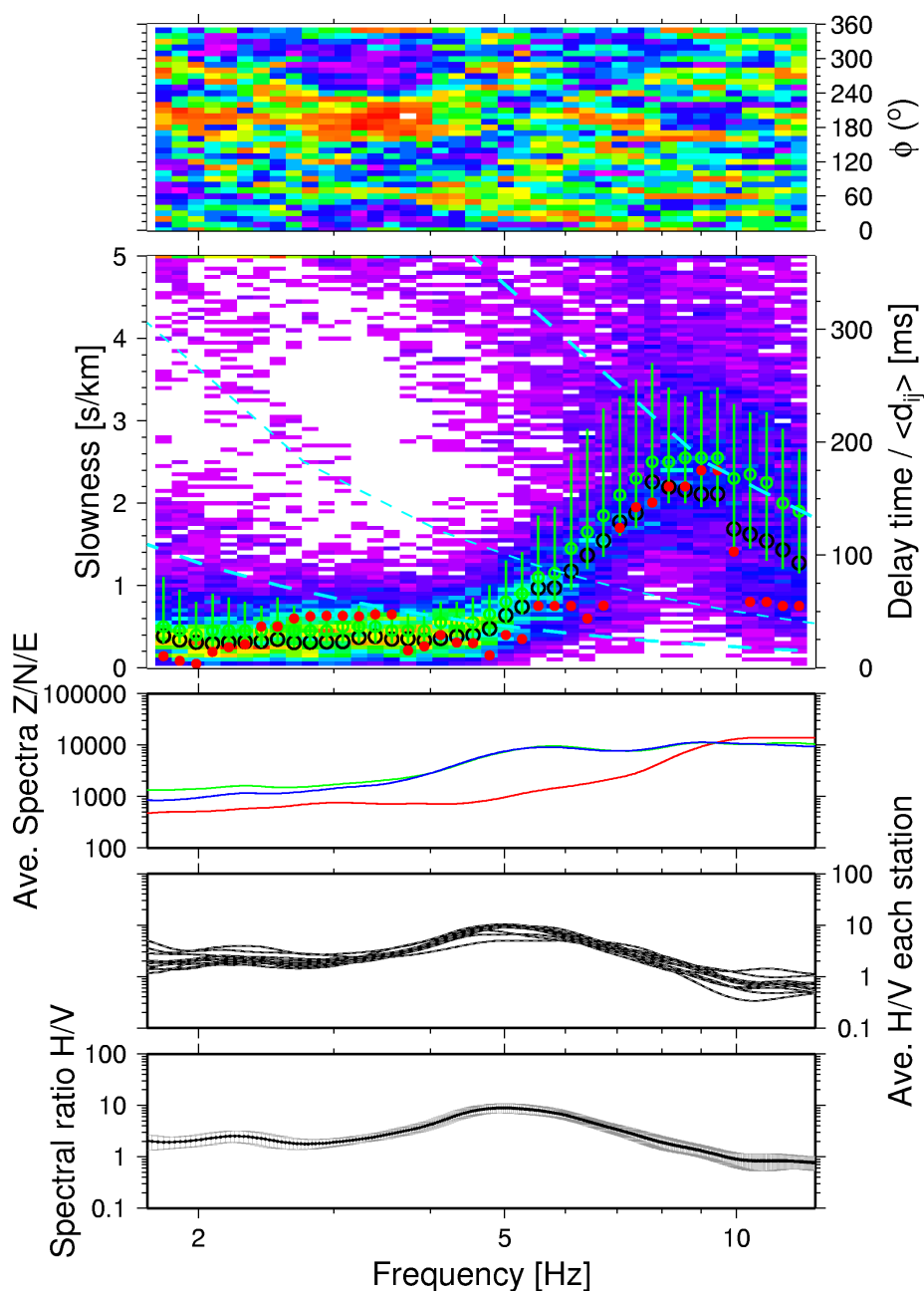
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D07.05 - Appendix 3 - Figure 1 Results of FK-analysis for site Baviere (Liege, Belgium) - I.



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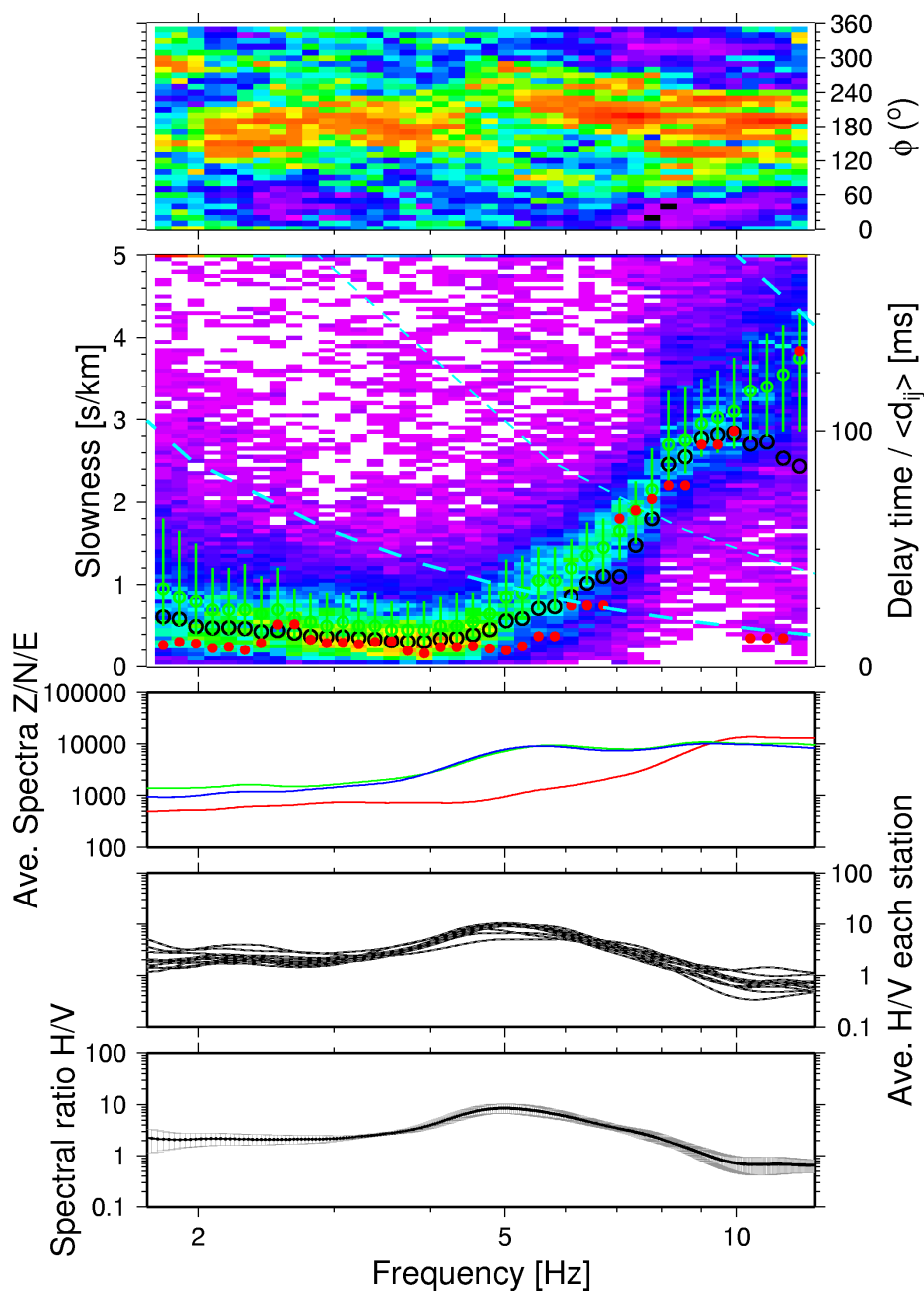
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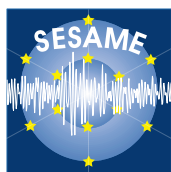
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D07.05 - Appendix 3 - Figure 2 Results of FK-analysis for site Baviere (Liege, Belgium) - II.



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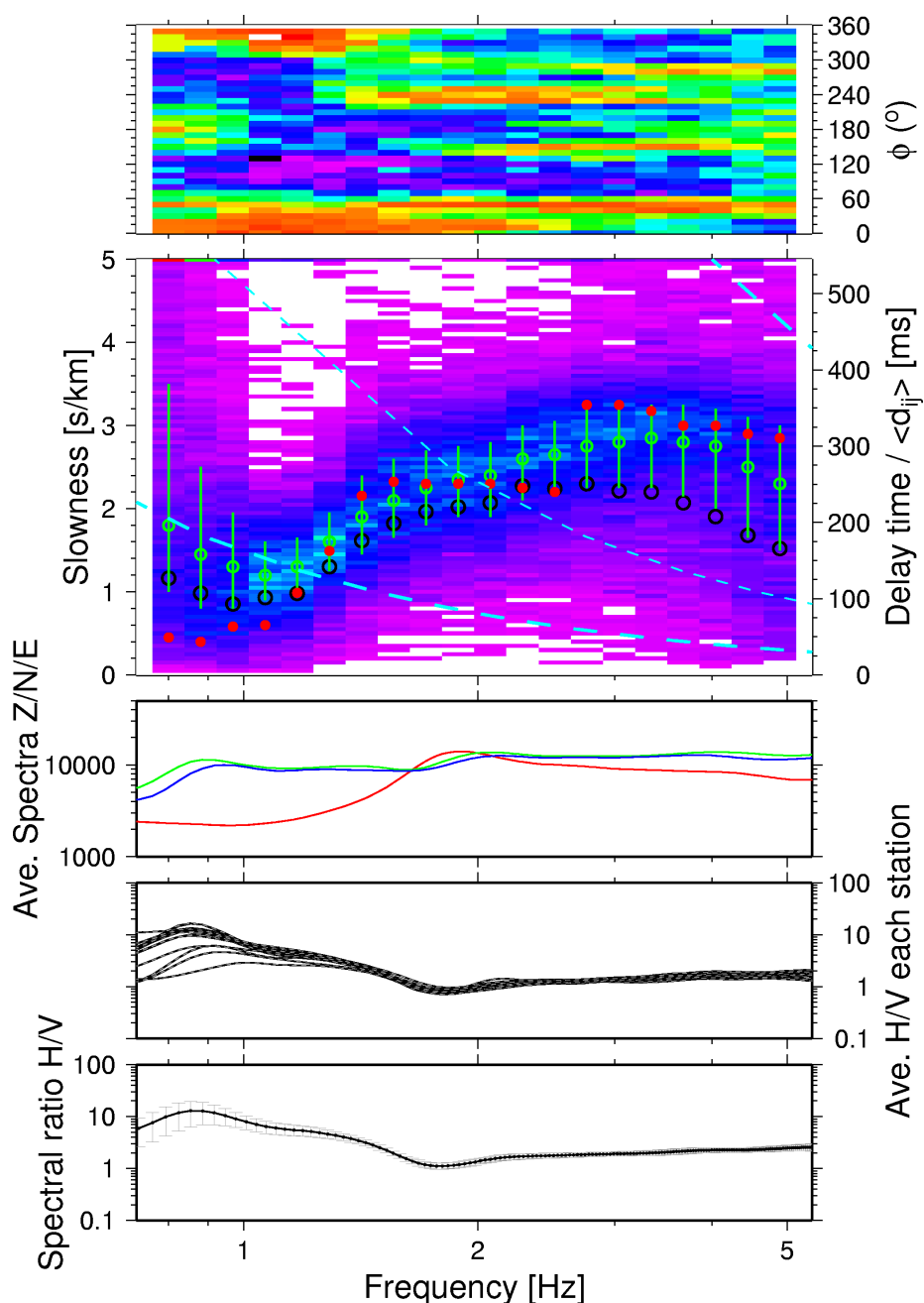
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D07.05 - Appendix 3 - Figure 3 Results of FK-analysis for site Uccle (Brussels, Belgium) - I.



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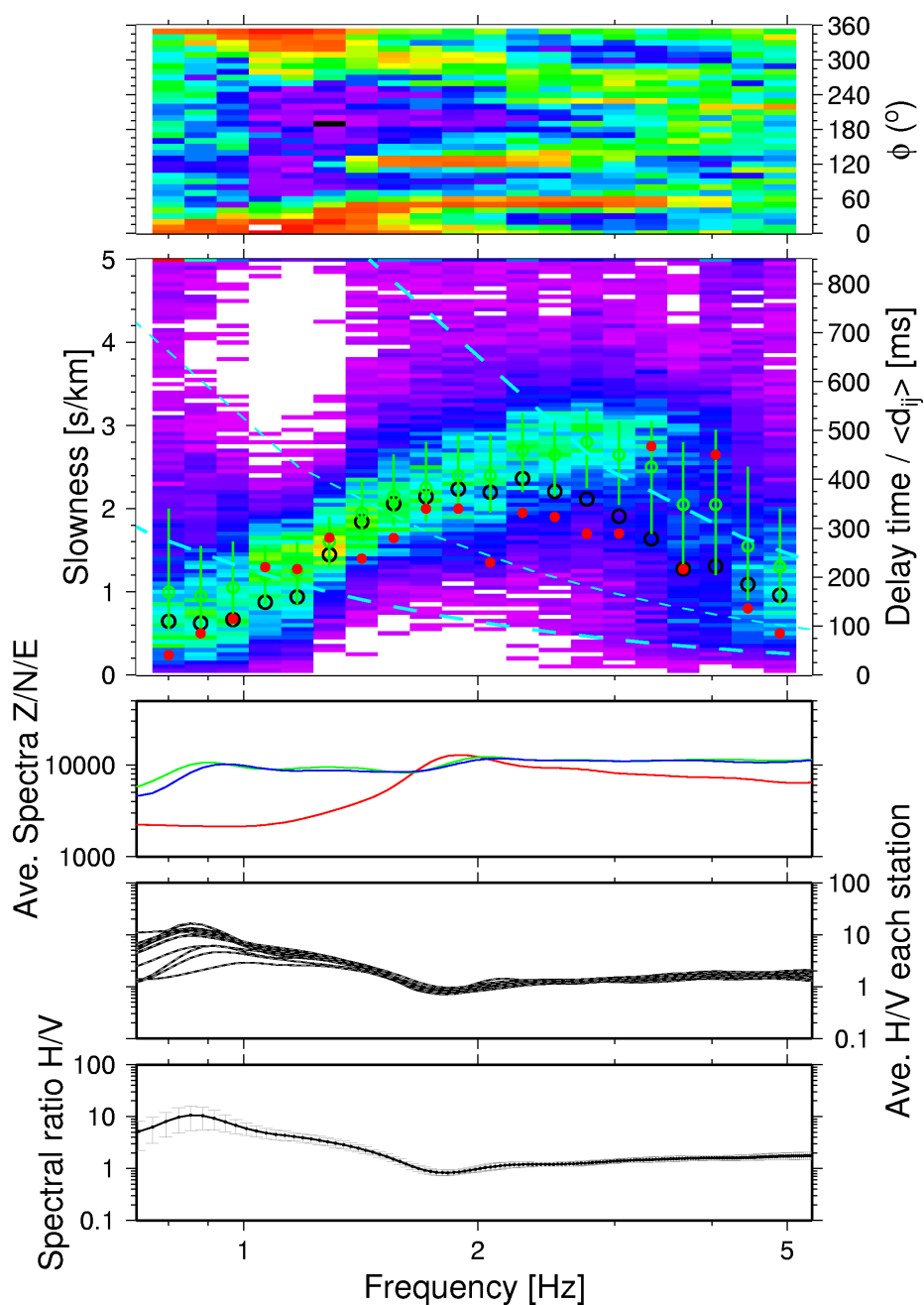
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D07.05 - Appendix 3 - Figure 4 Results of FK-analysis for site Uccle (Brussels, Belgium) - II.



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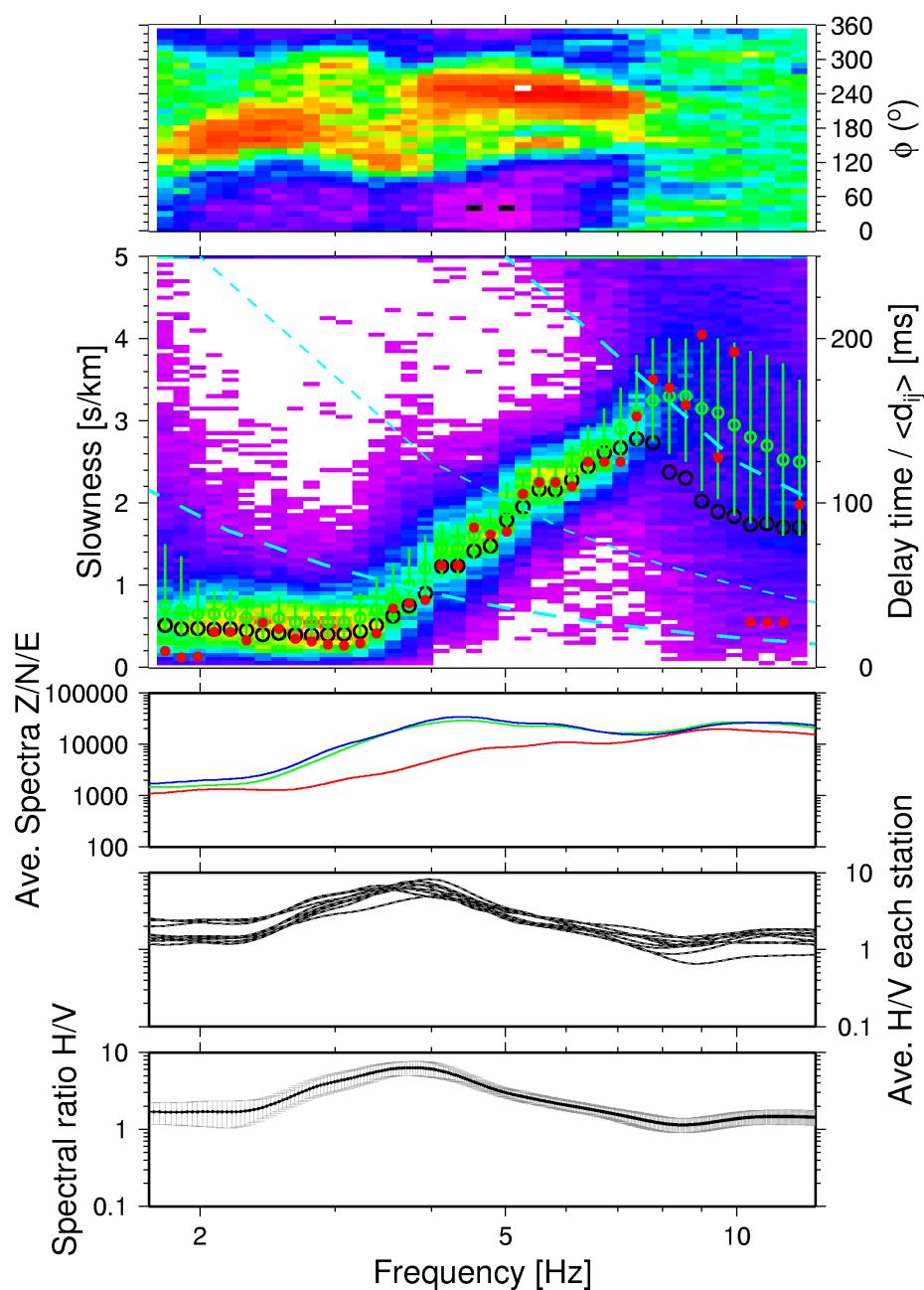
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D07.05 - Appendix 3 - Figure 5 Results of FK-analysis for site Botanique (Liege, Belgium).



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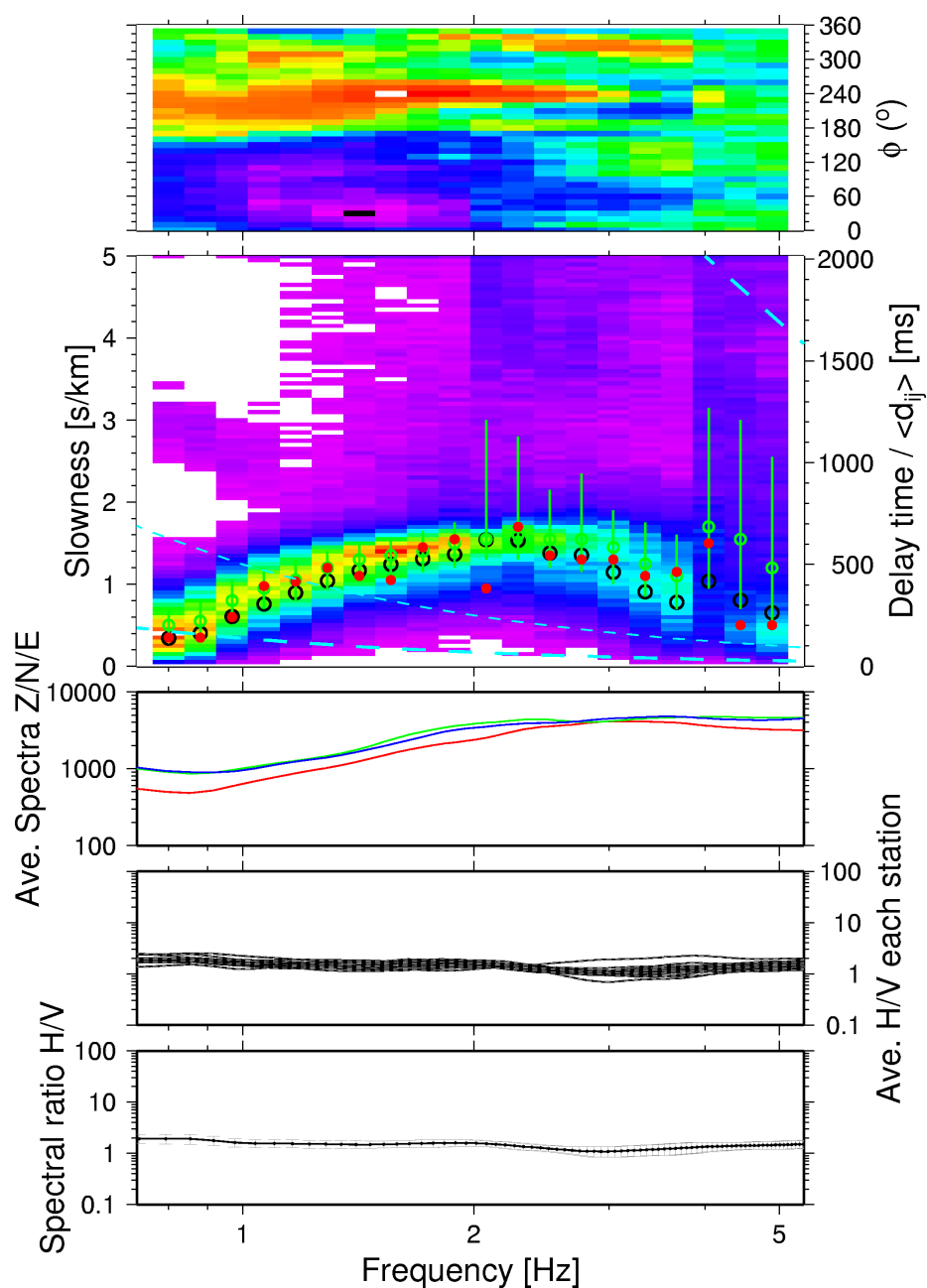
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D07.05 - Appendix 3 - Figure 6 Results of FK-analysis for site Otterbach (Weil am Rhein, German-Swiss border region) - I.



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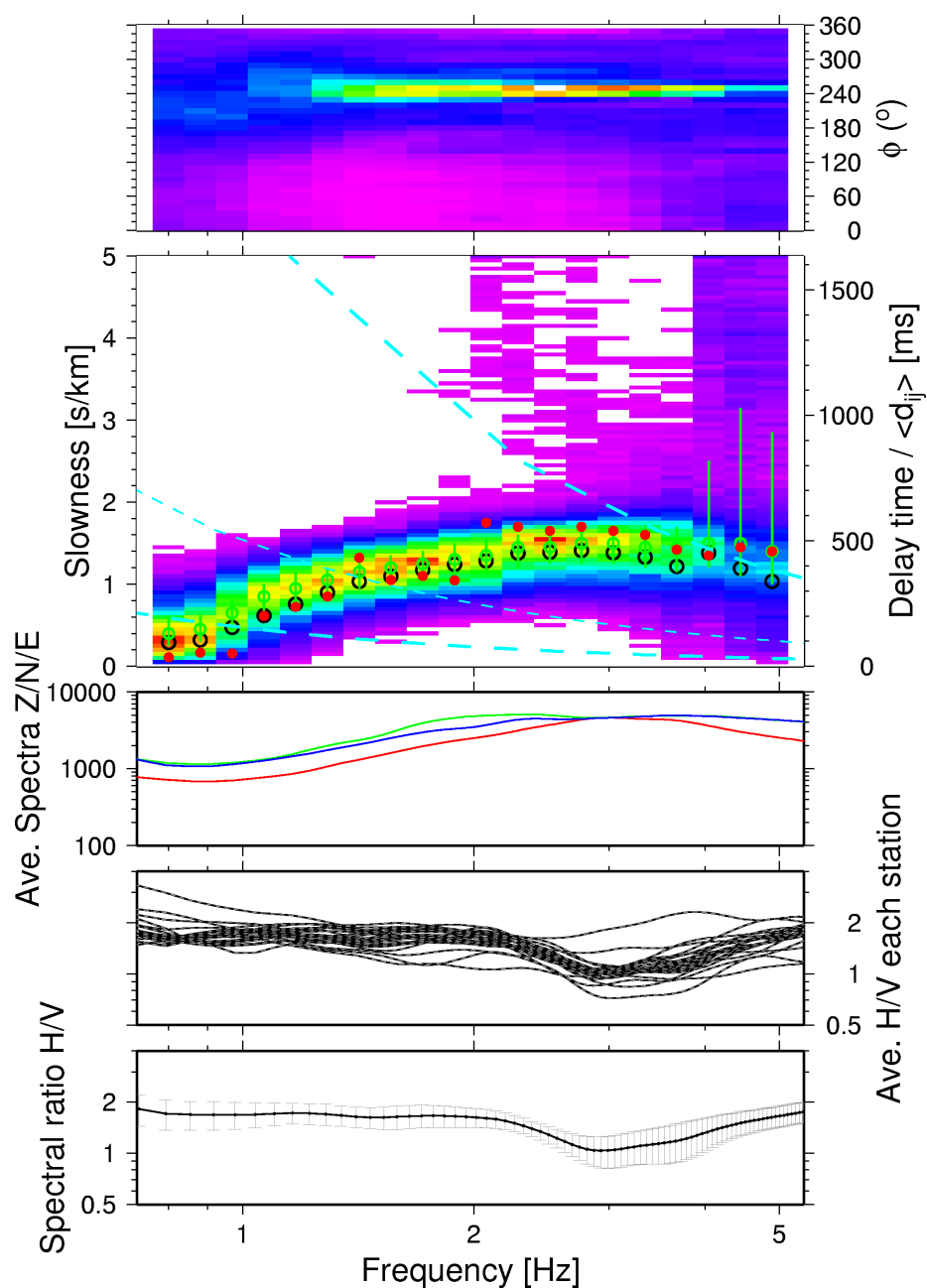
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D07.05 - Appendix 3 - Figure 7 Results of FK-analysis for site Otterbach (Weil am Rhein, German-Swiss border region) - II.



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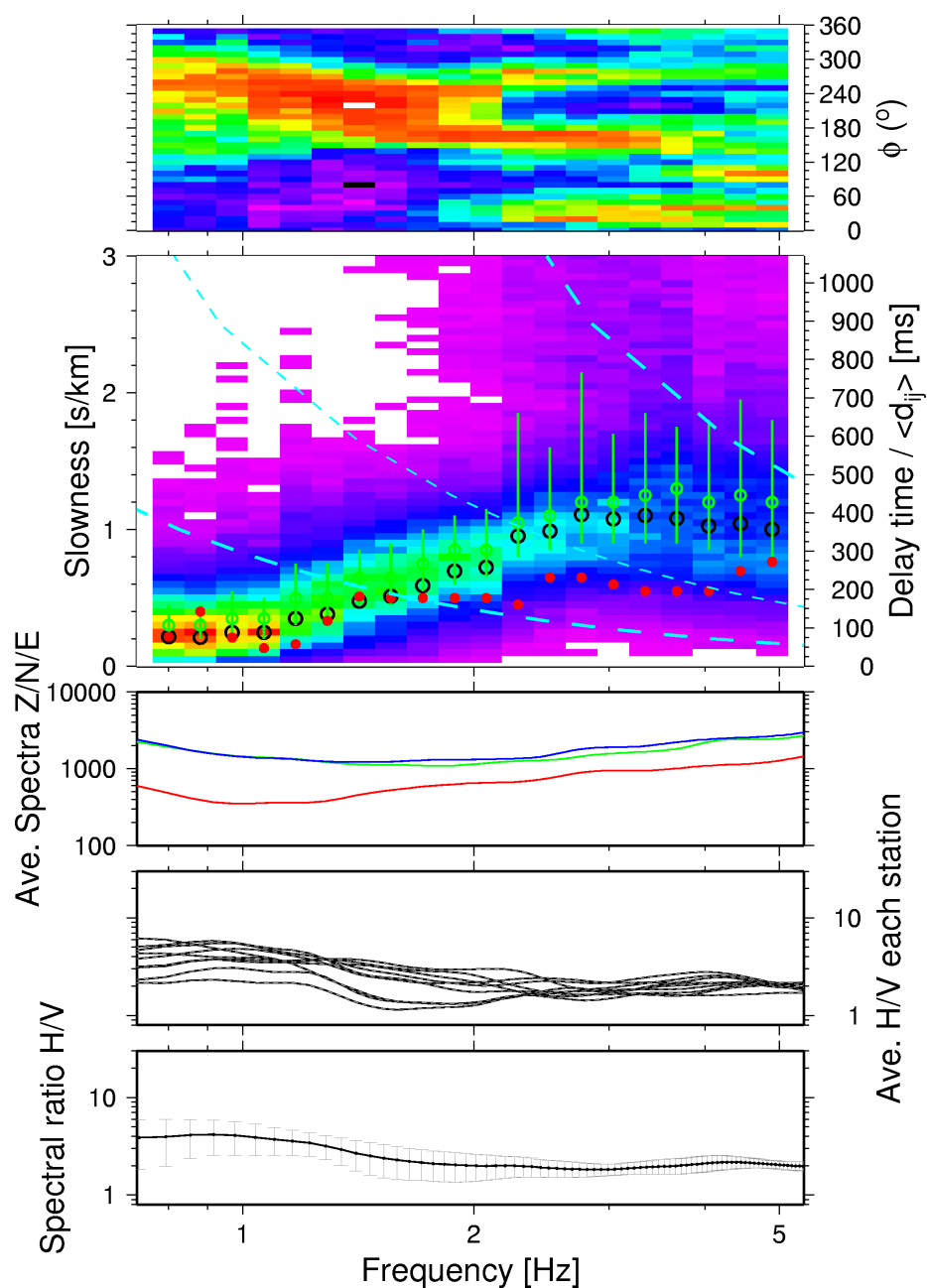
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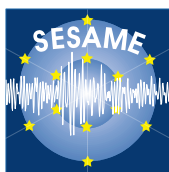
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D07.05 - Appendix 3 - Figure 8 Results of FK-analysis for site Lörrach (Lörrach, German-Swiss border region).



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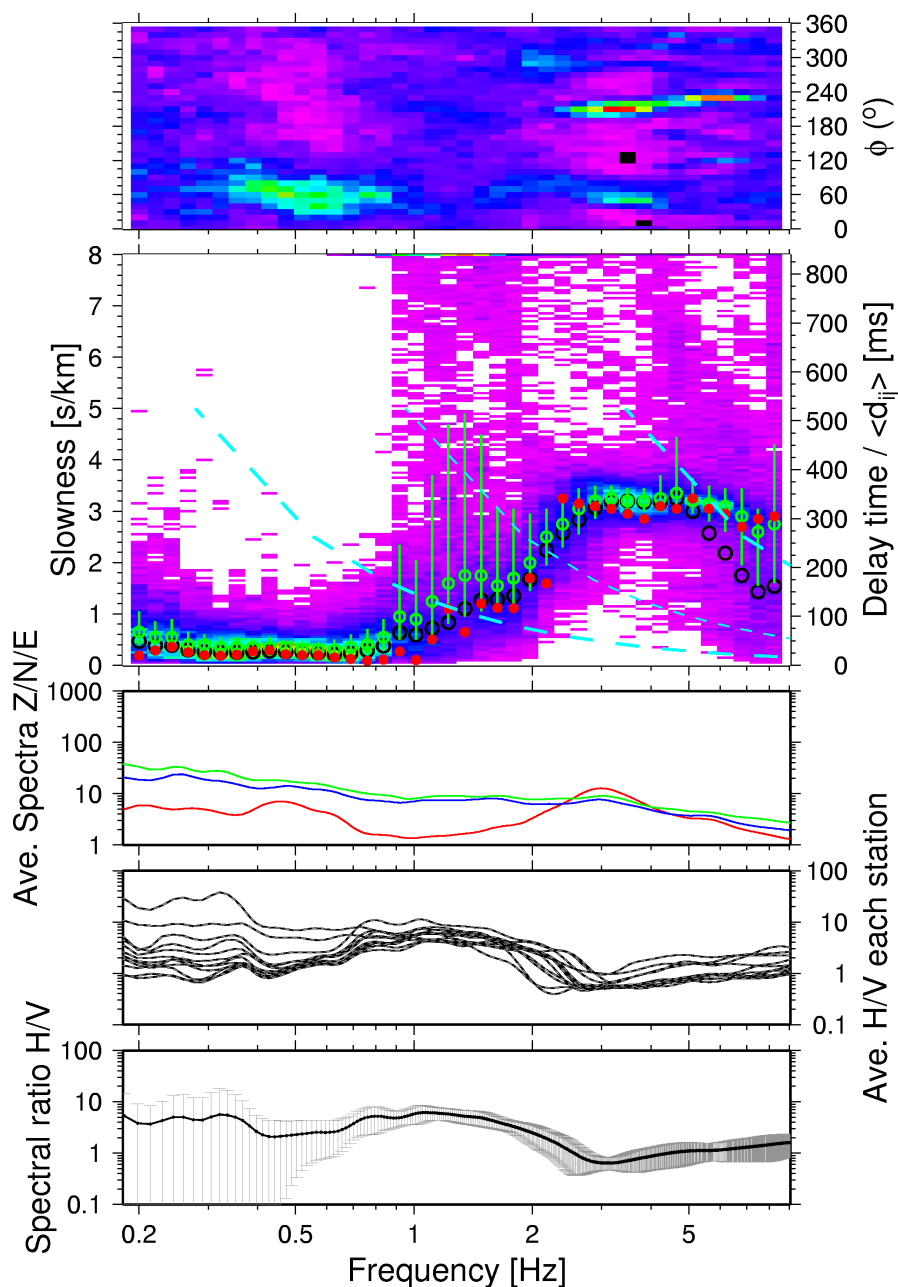
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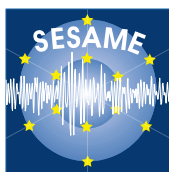
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D07.05 - Appendix 3 - Figure 9 Results of FK-analysis for site colfA (Colfiorito, Umbria, Italy).



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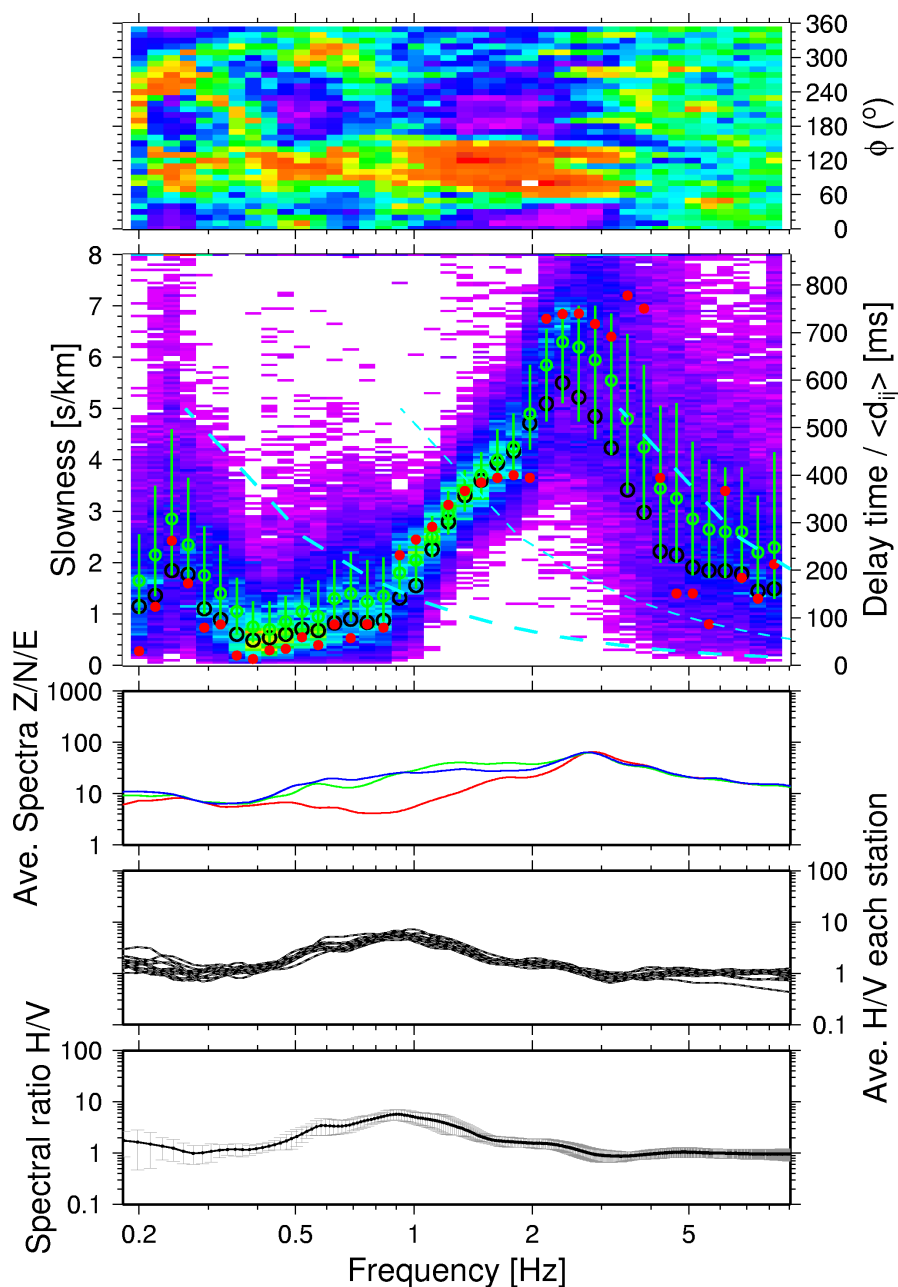
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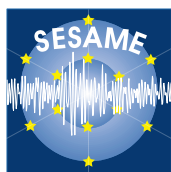
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D07.05 - Appendix 3 - Figure 10 Results of FK-analysis for site colfB (Colfiorito, Umbria, Italy).



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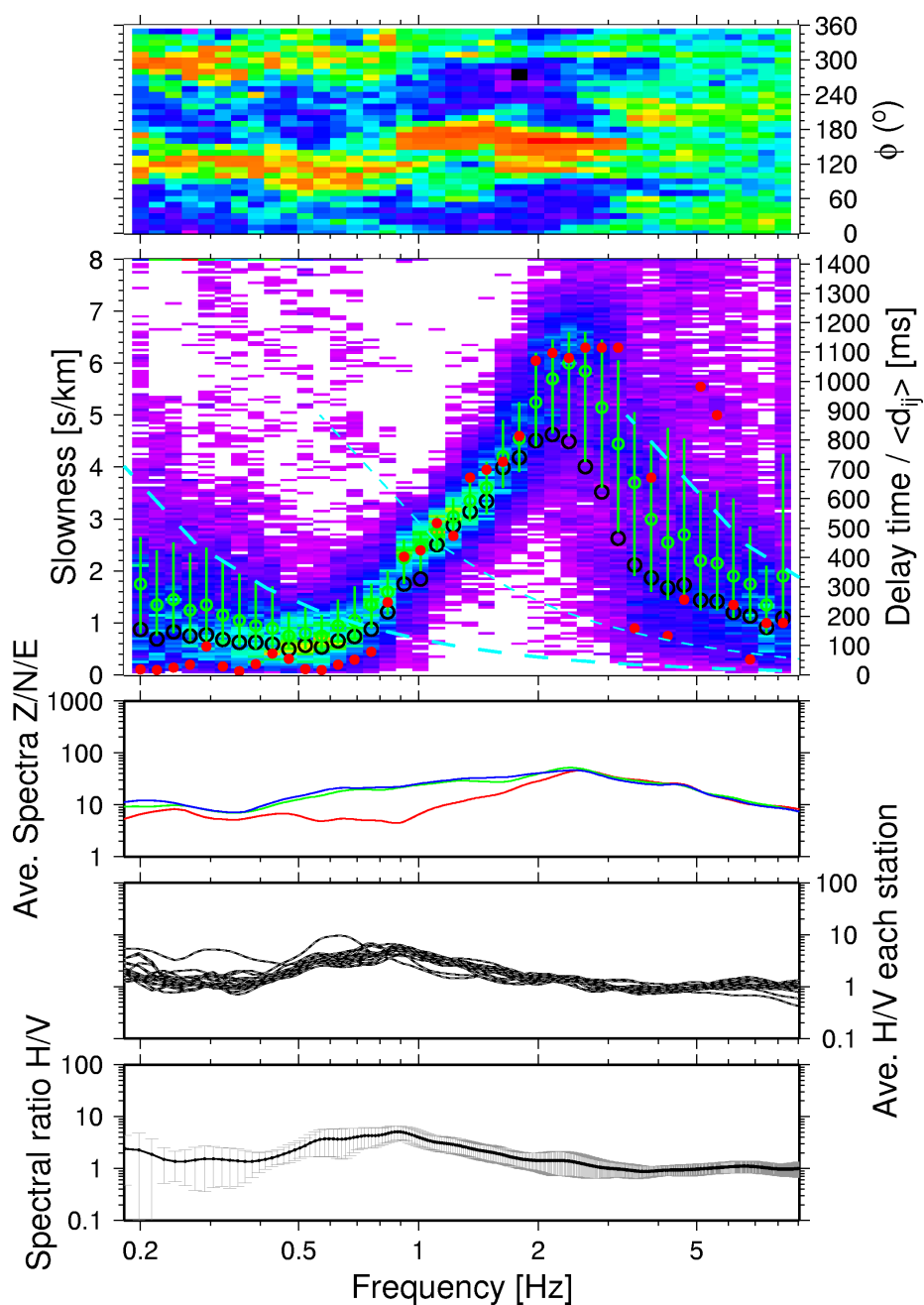
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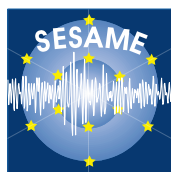
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D07.05 - Appendix 3 - Figure 11 Results of FK-analysis for site colfBLarge (Colfiorito, Umbria, Italy).



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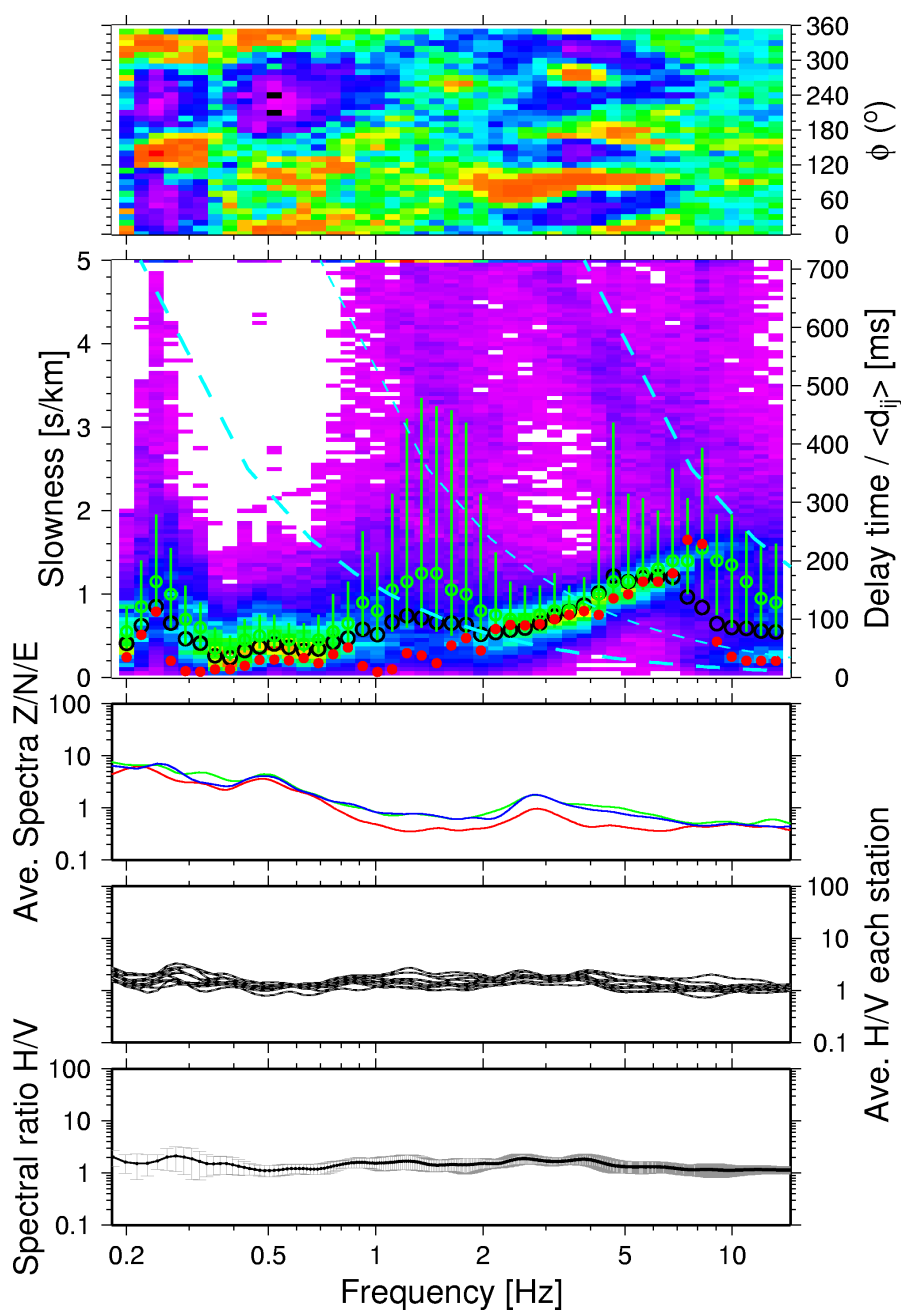
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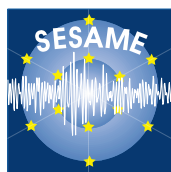
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D07.05 - Appendix 3 - Figure 12 Results of FK-analysis for site colfC (Colfiorito, Umbria, Italy).



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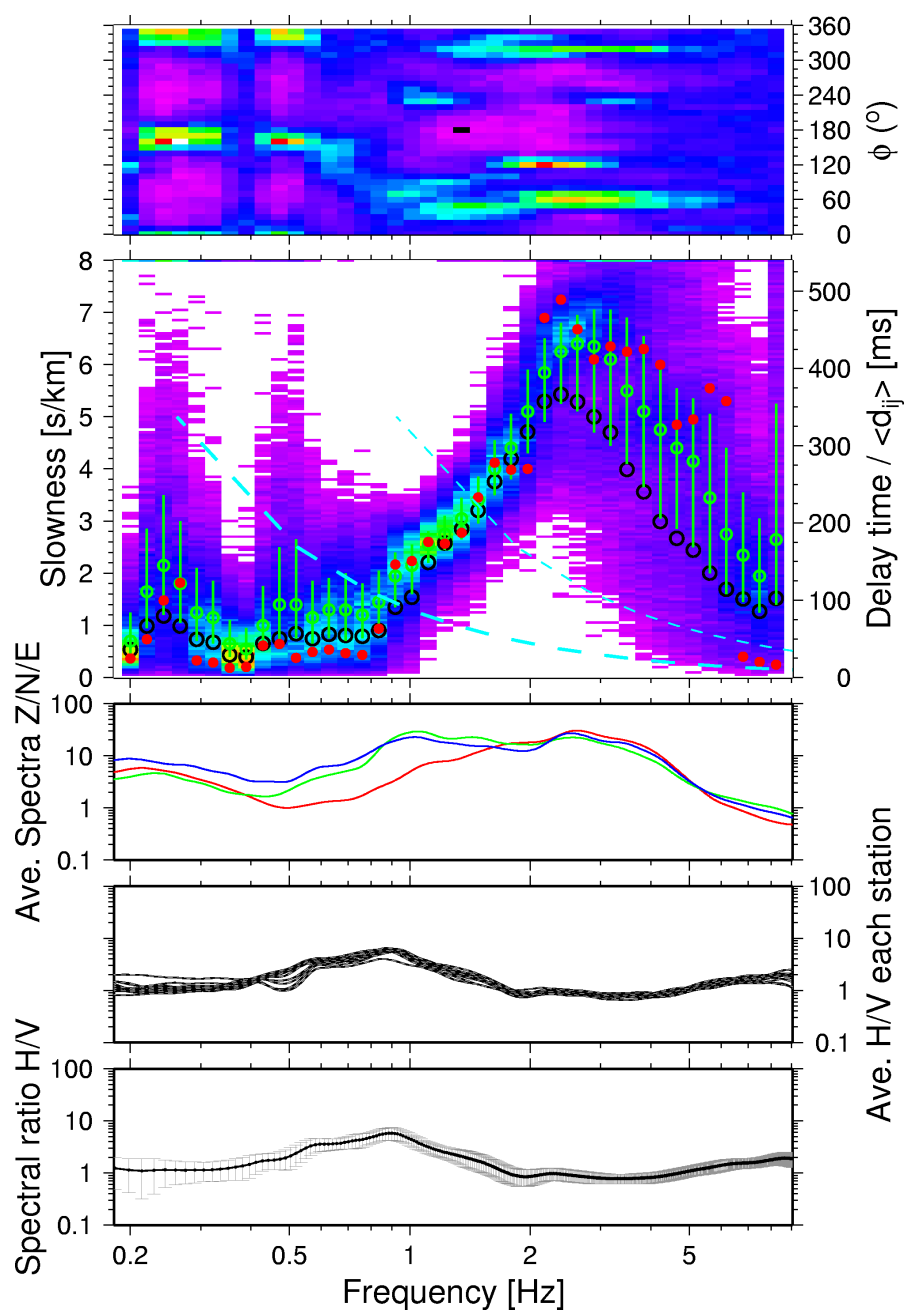
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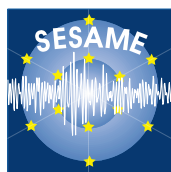
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D07.05 - Appendix 3 - Figure 13 Results of FK-analysis for site colfD (Colfiorito, Umbria, Italy).



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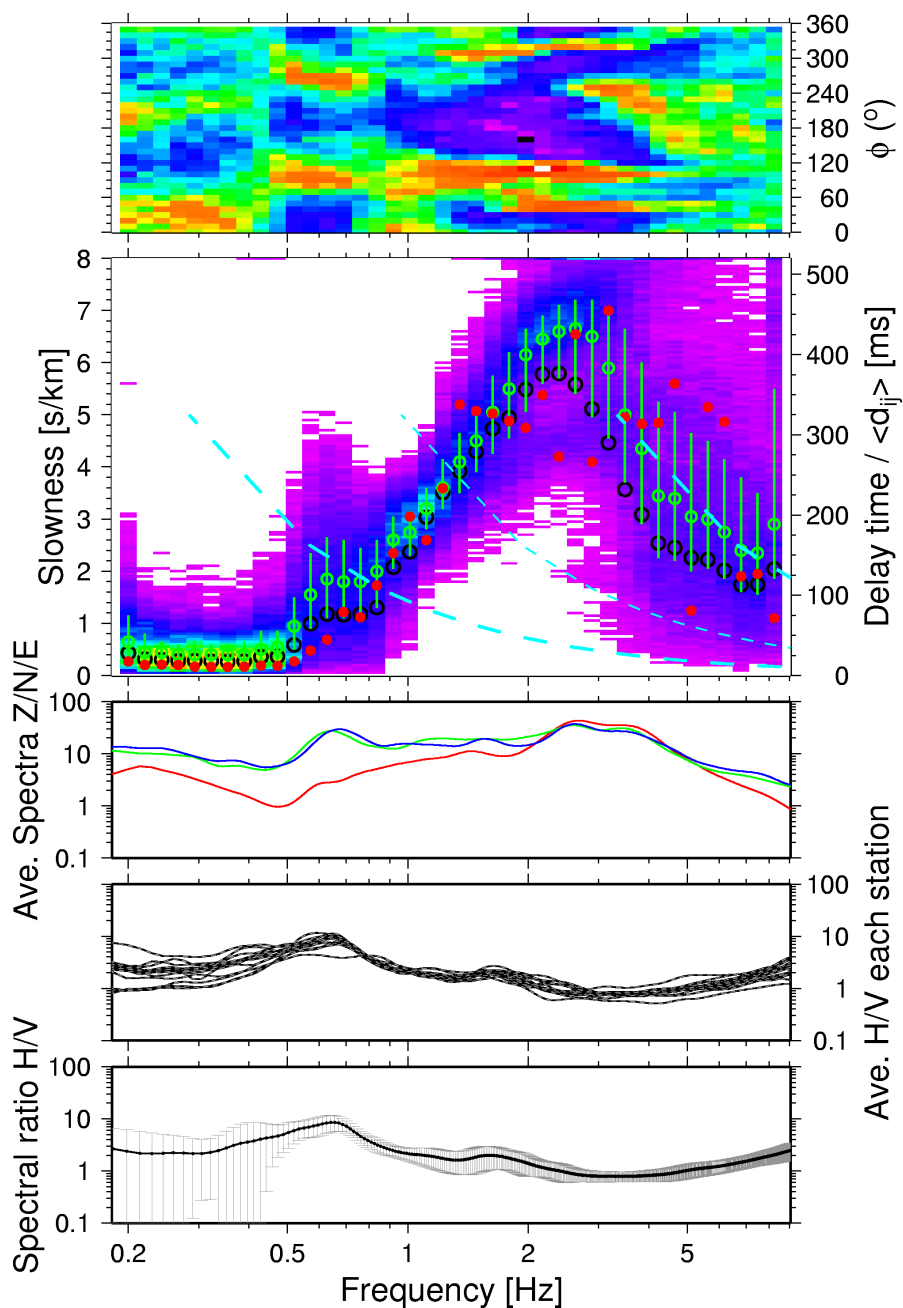
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D07.05 - Appendix 3 - Figure 14 Results of FK-analysis for site colfE (Colfiorito, Umbria, Italy).



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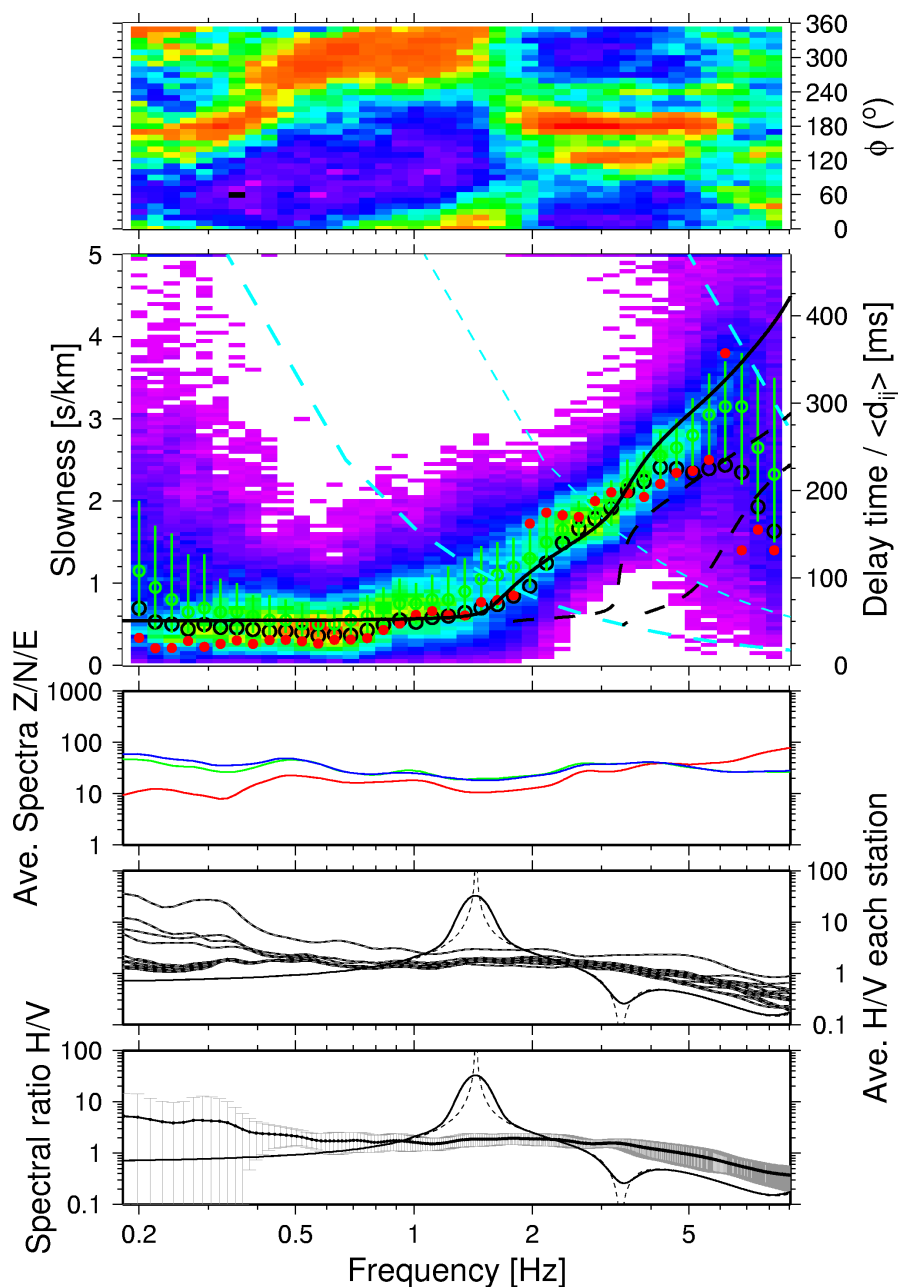
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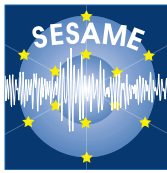
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D07.05 - Appendix 3 - Figure 15 Results of FK-analysis for site Lefkas (Lefkas, NW-Greece).



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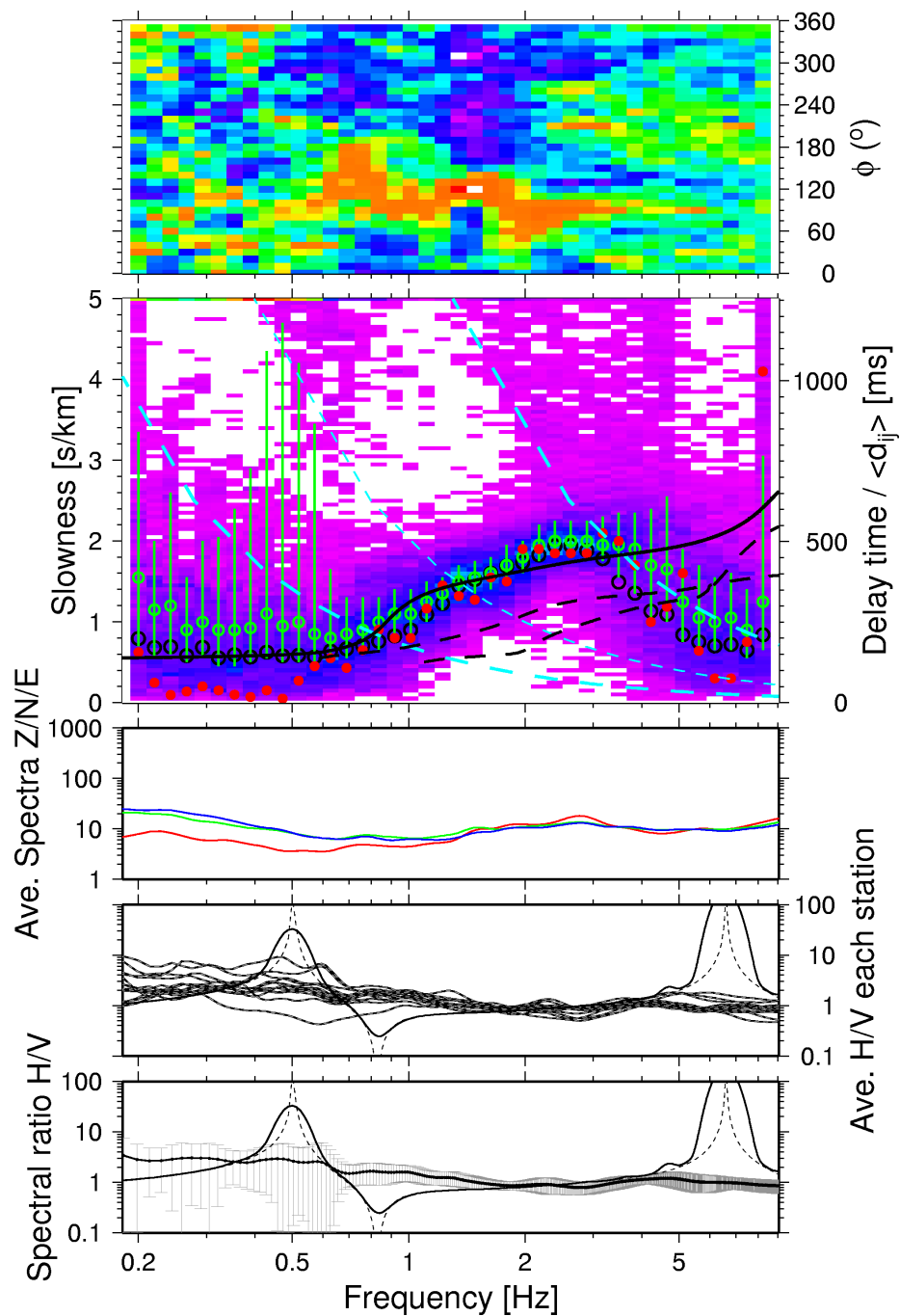
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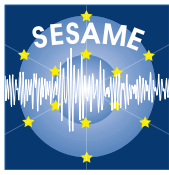
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D07.05 - Appendix 3 - Figure 16 Results of FK-analysis for site KAL (Thessaloniki, Greece).



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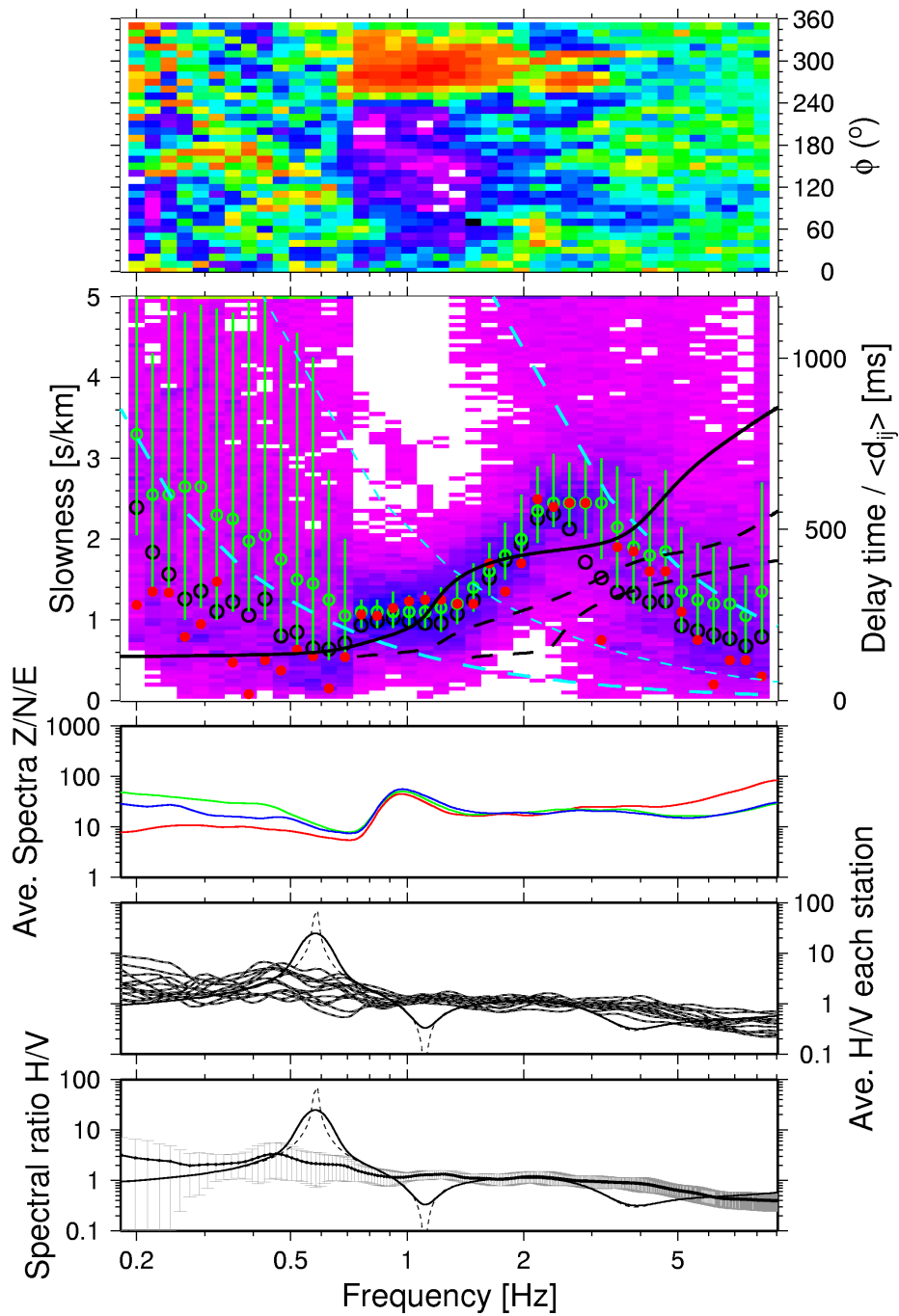
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D07.05 - Appendix 3 - Figure 17 Results of FK-analysis for site VILLA (Thessaloniki, Greece).



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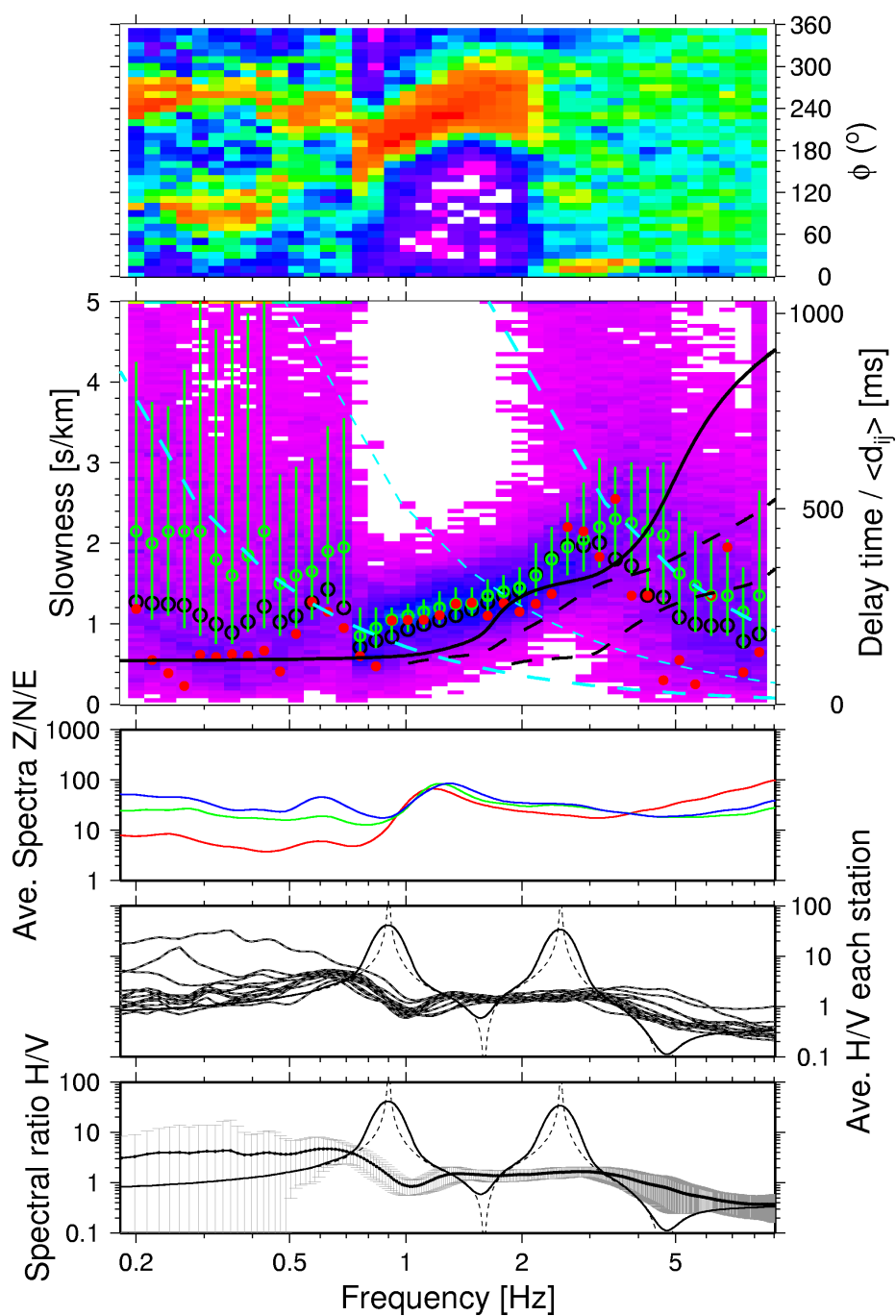
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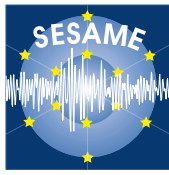
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D07.05 - Appendix 3 - Figure 18 Results of FK-analysis for site TYF (Thessaloniki, Greece).



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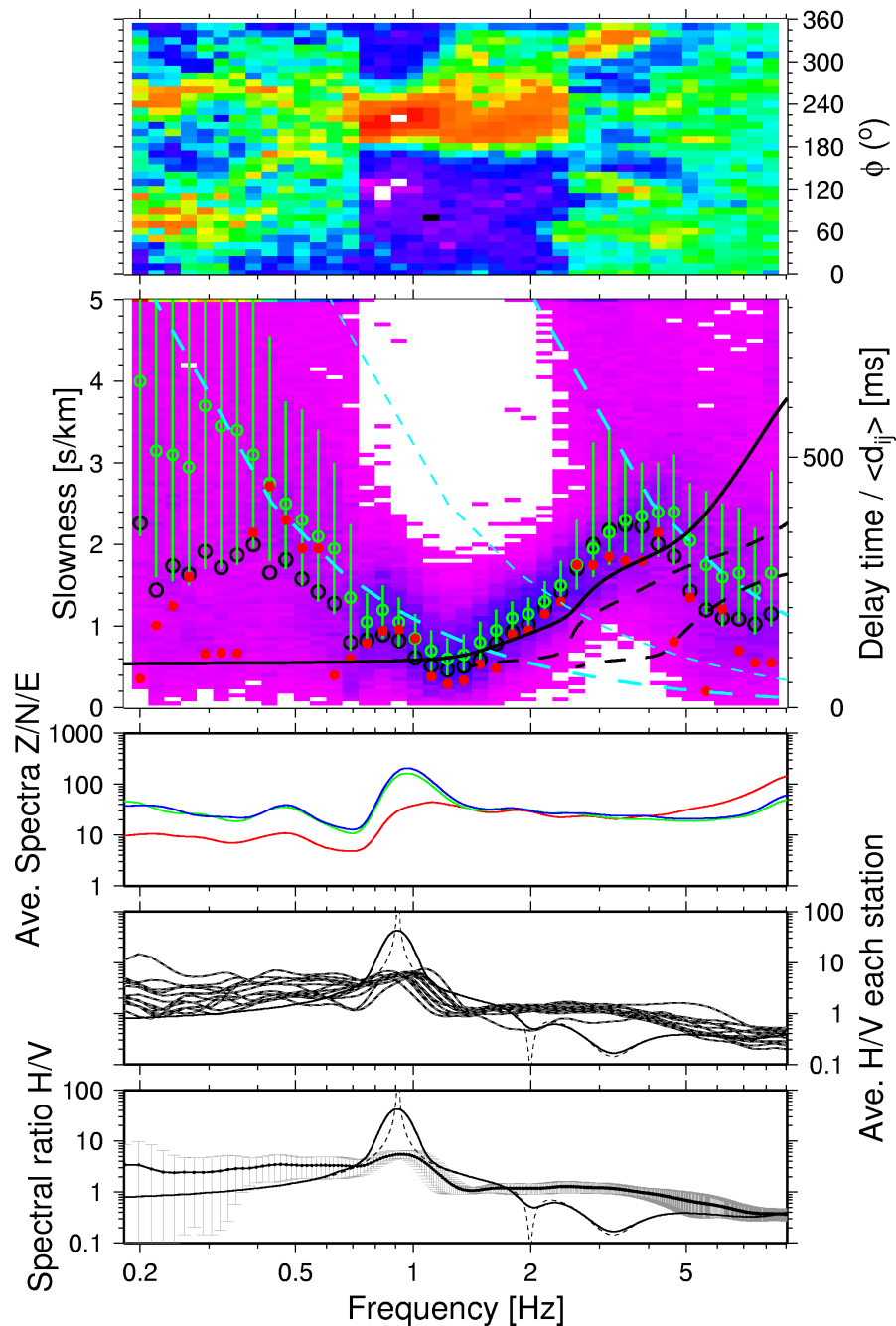
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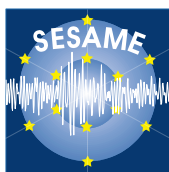
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D07.05 - Appendix 3 - Figure 19 Results of FK-analysis for site LEP (Thessaloniki, Greece).



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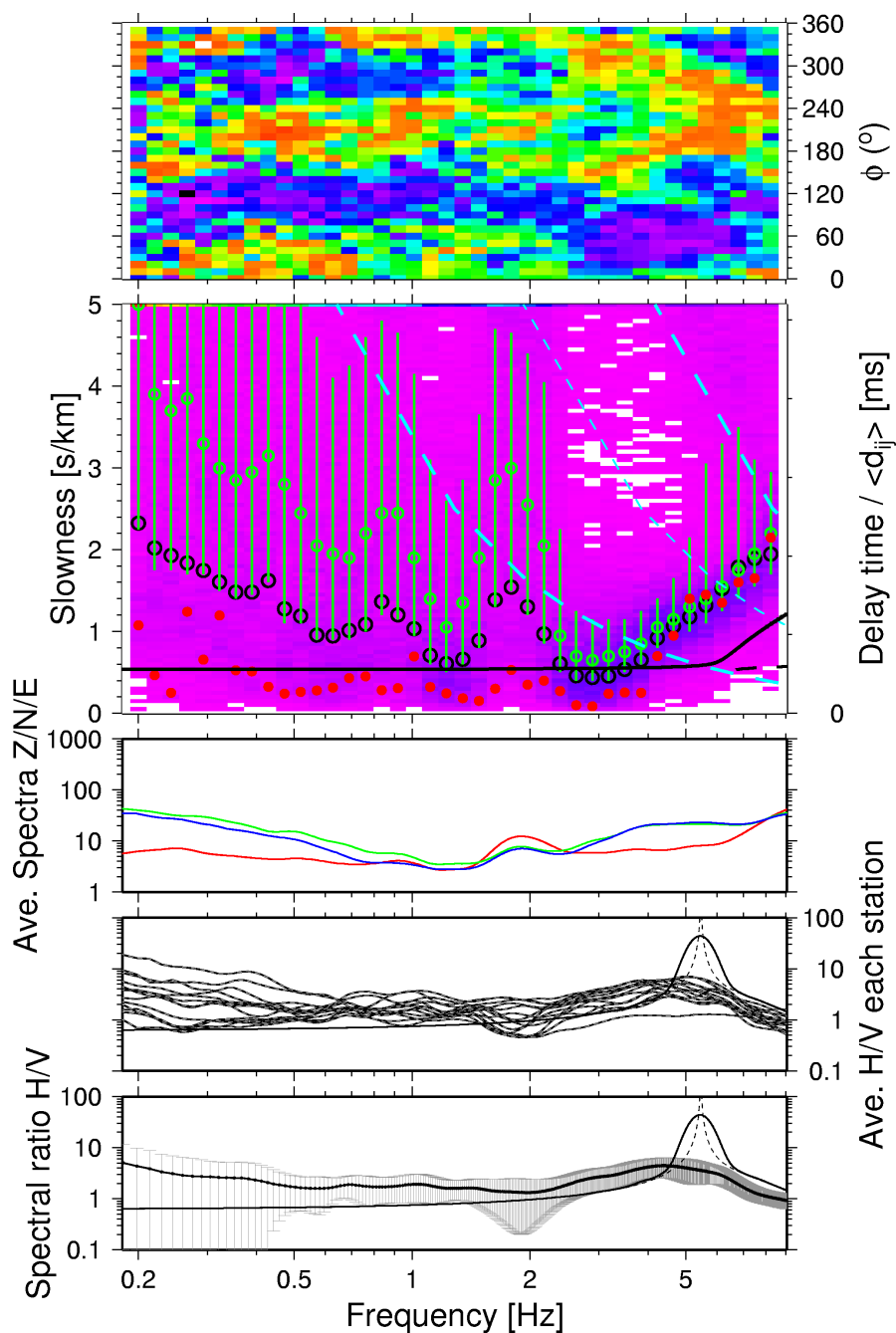
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D07.05 - Appendix 3 - Figure 20 Results of FK-analysis for site AGO (Thessaloniki, Greece).



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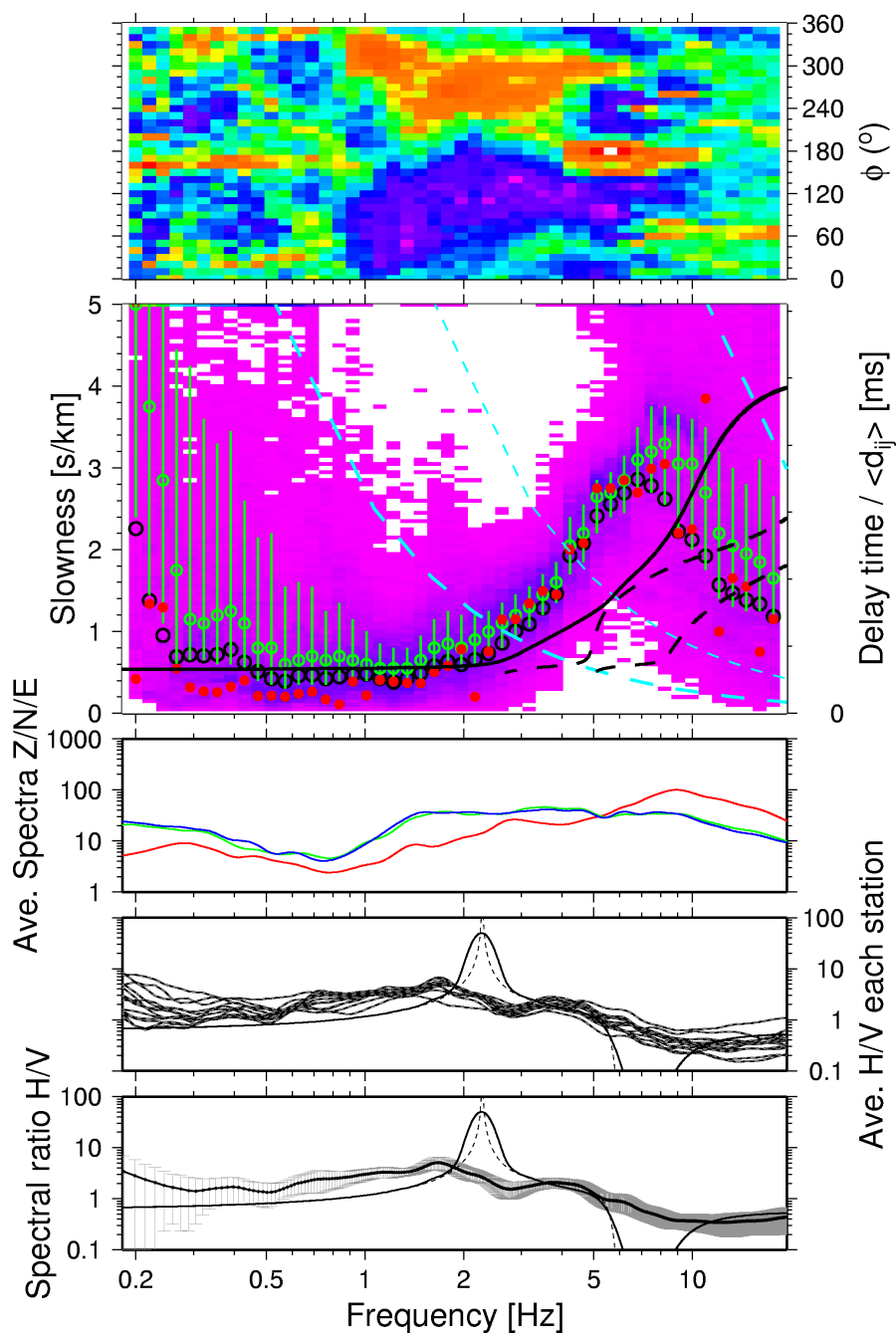
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D07.05 - Appendix 3 - Figure 21 Results of FK-analysis for site OTE (Thessaloniki, Greece).



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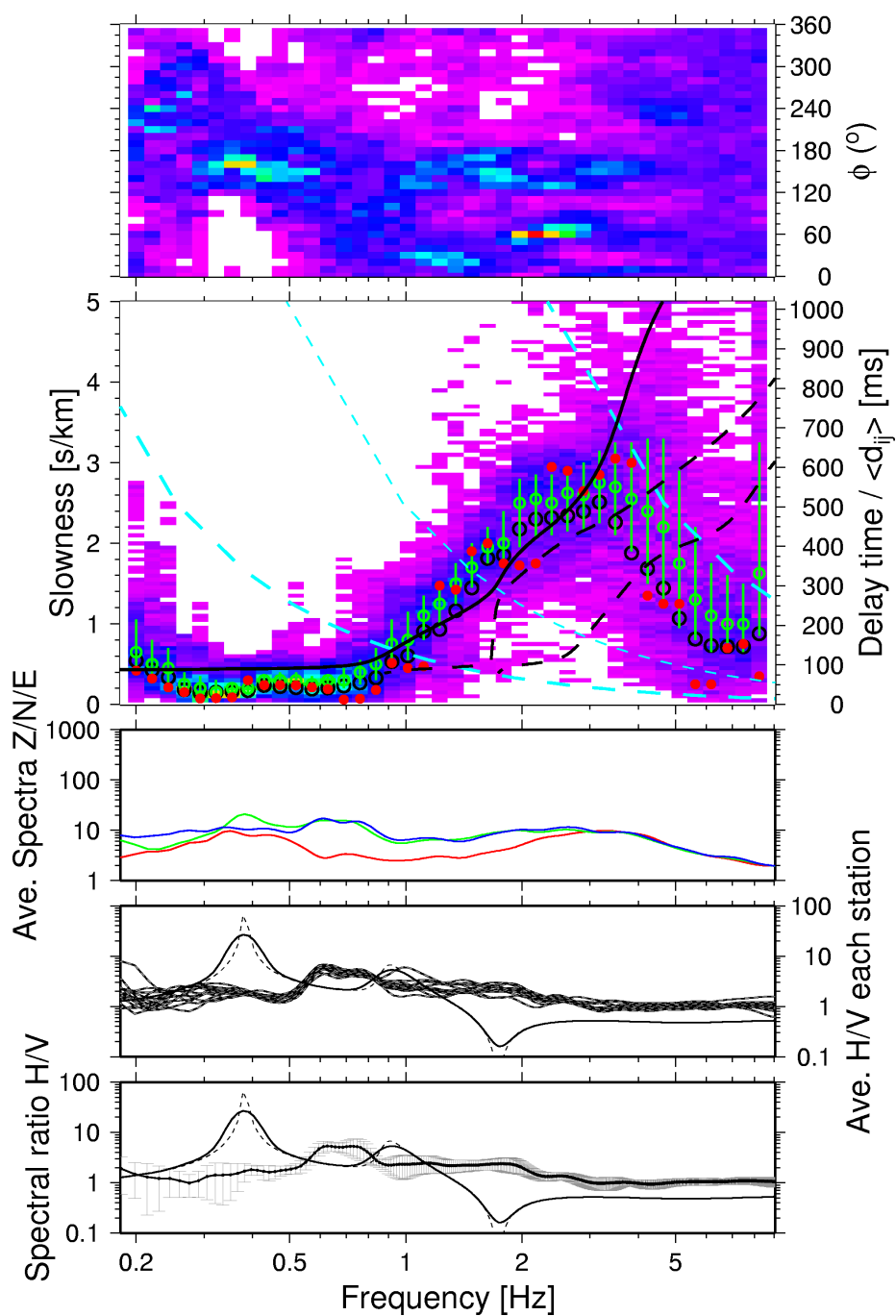
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D07.05 - Appendix 3 - Figure 22 Results of FK-analysis for site TST (Euroseis-test site, Volvi graben, Greece) – I.



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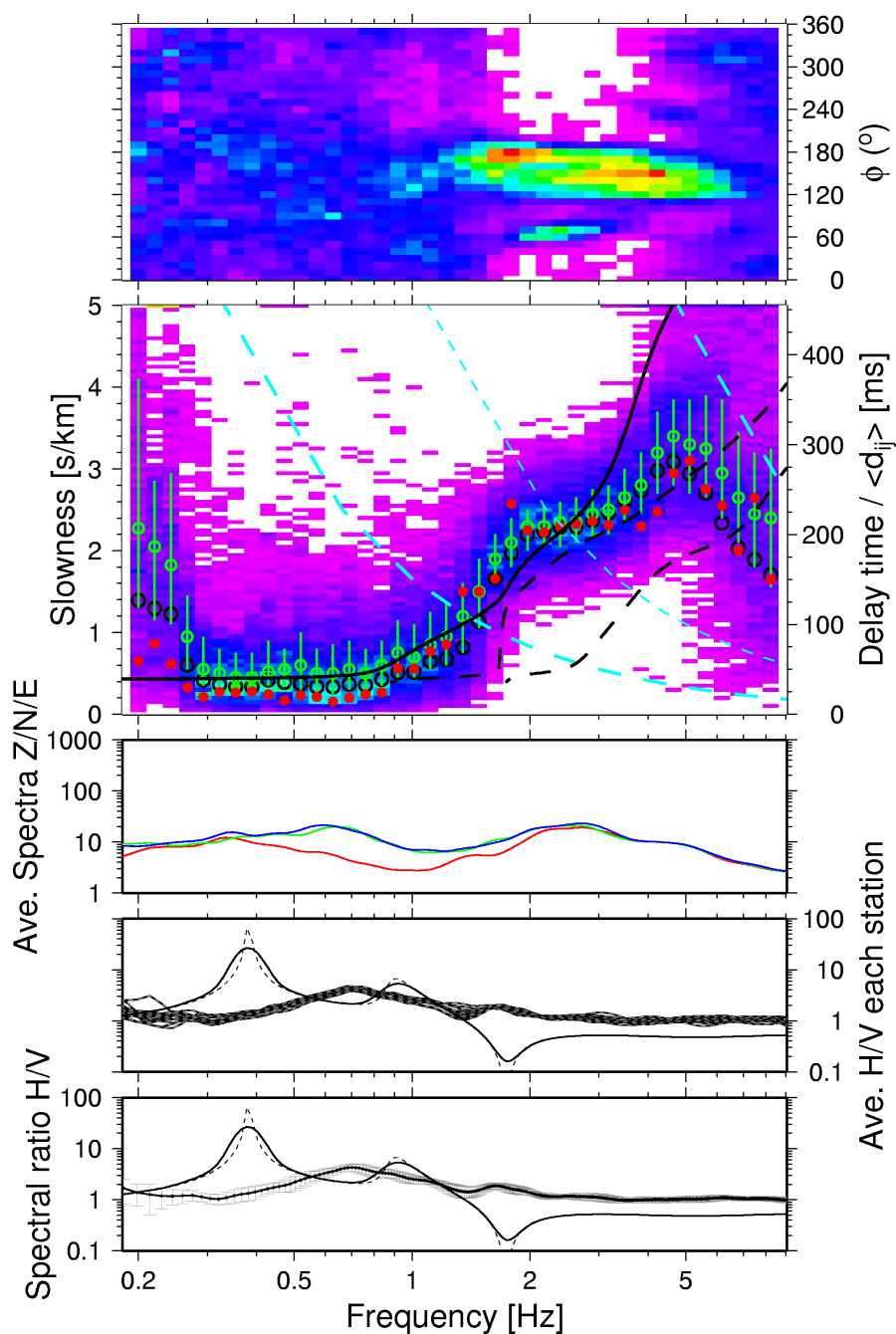
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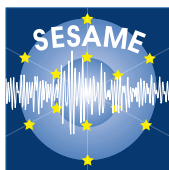
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D07.05 - Appendix 3 - Figure 23 Results of FK-analysis for site TST (Euroseis-test site, Volvi graben, Greece) – II.



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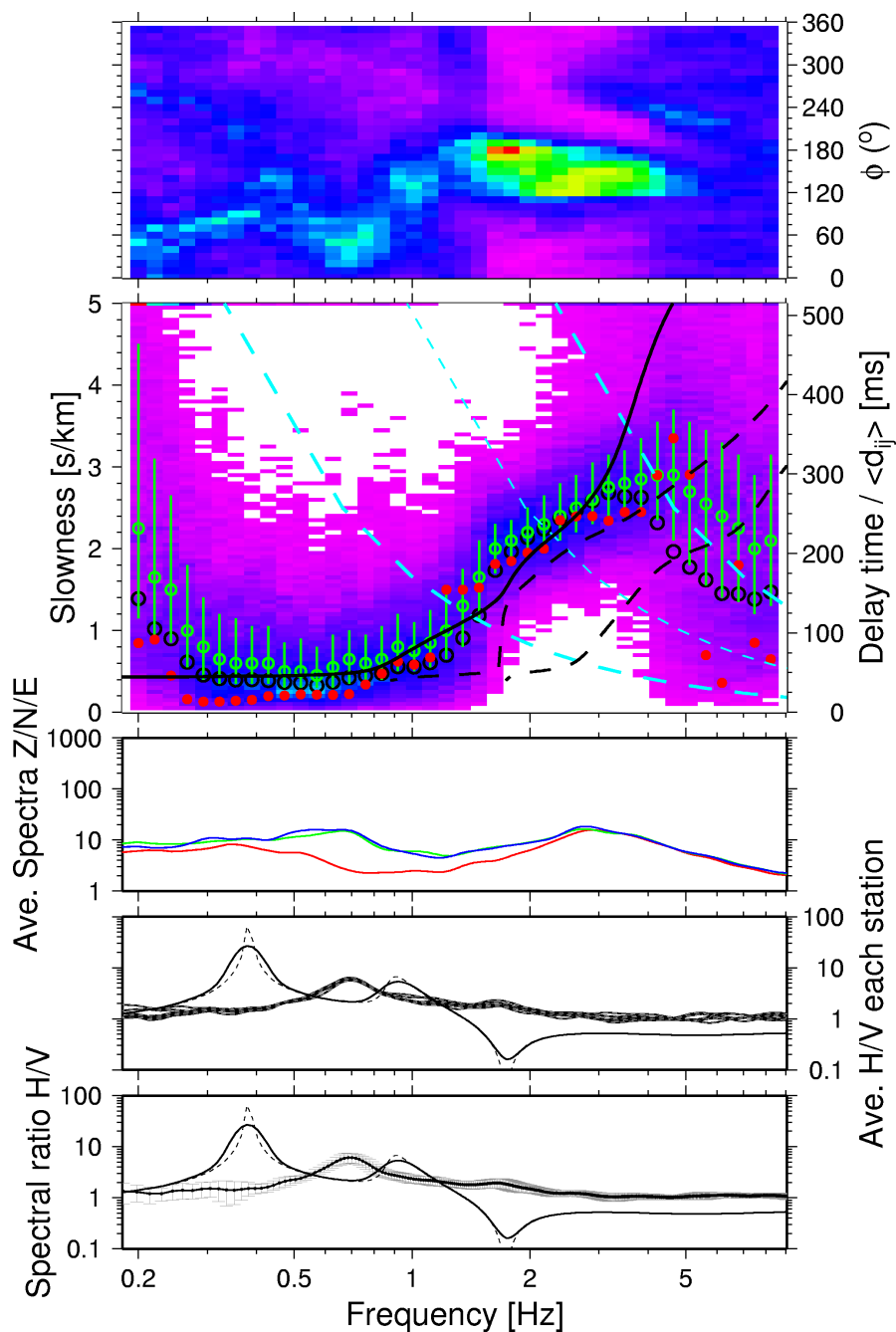
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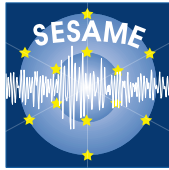
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D07.05 - Appendix 3 - Figure 24 Results of FK-analysis for site TST (Euroseis-test site, Volvi graben, Greece) – III.



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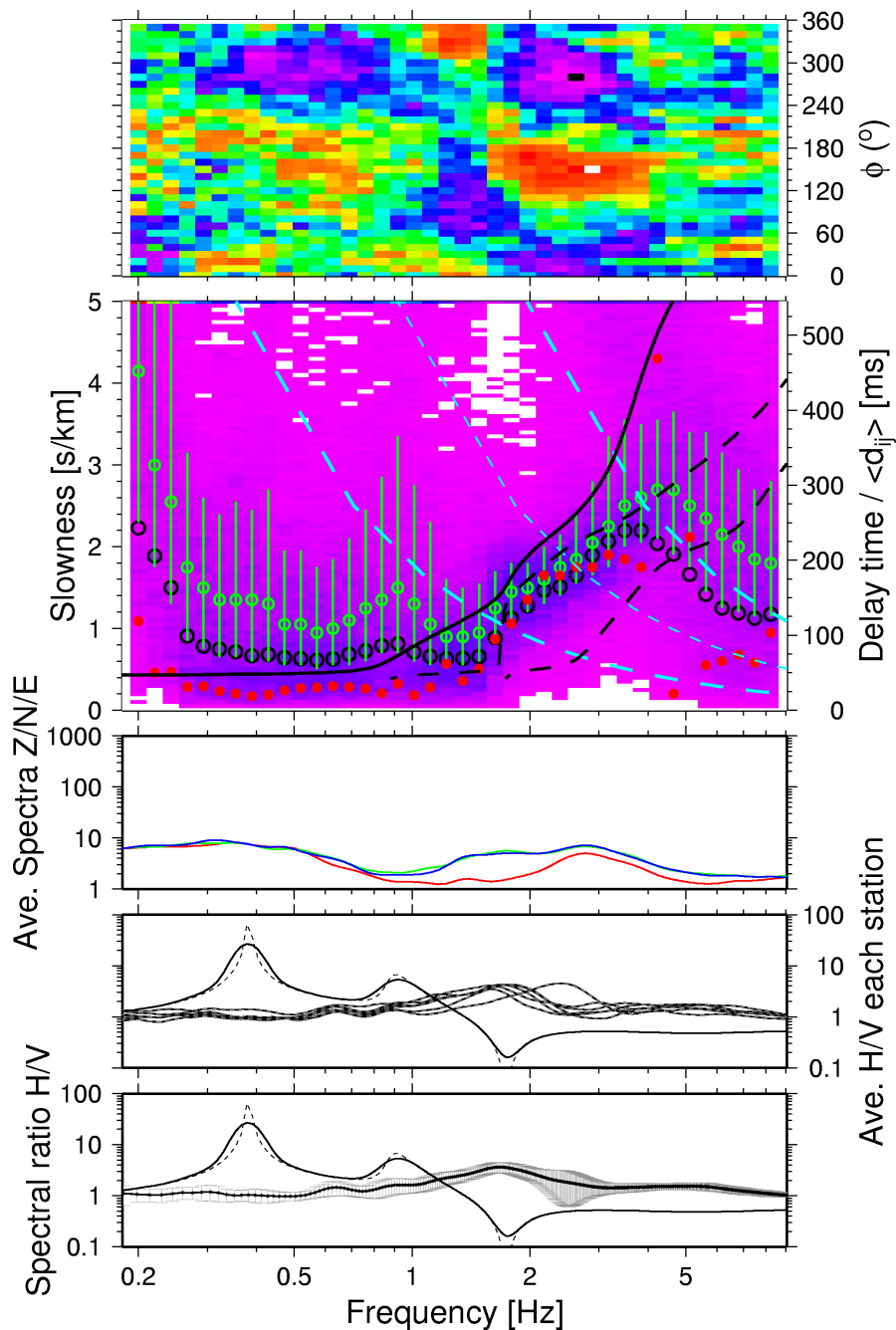
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D07.05 - Appendix 3 - Figure 25 Results of FK-analysis for site GA (borehole site, Volvi graben, Greece).



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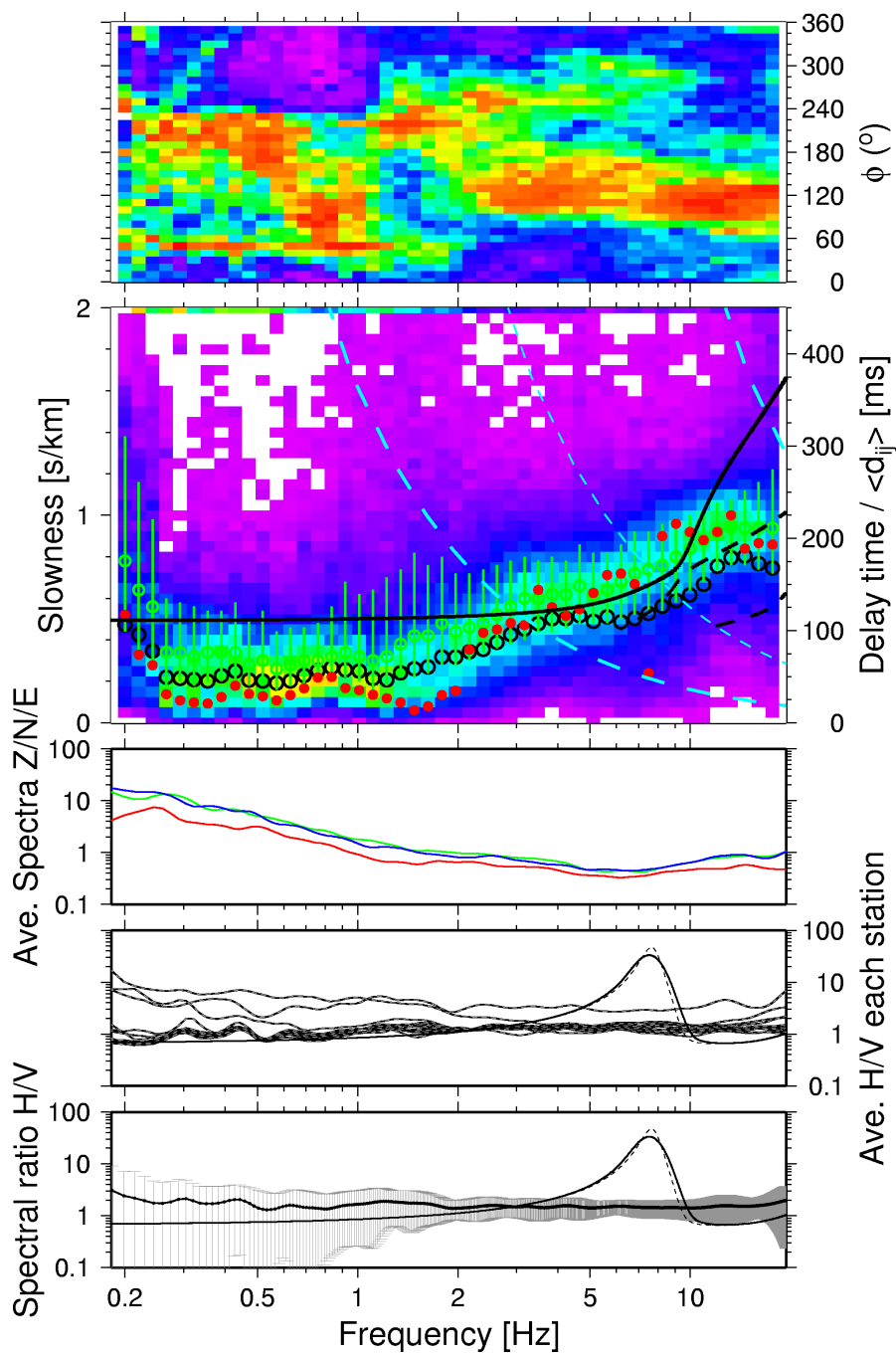
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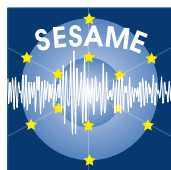
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D07.05 - Appendix 3 - Figure 26 Results of FK-analysis for site PRO (Volvi graben, Greece) – I.



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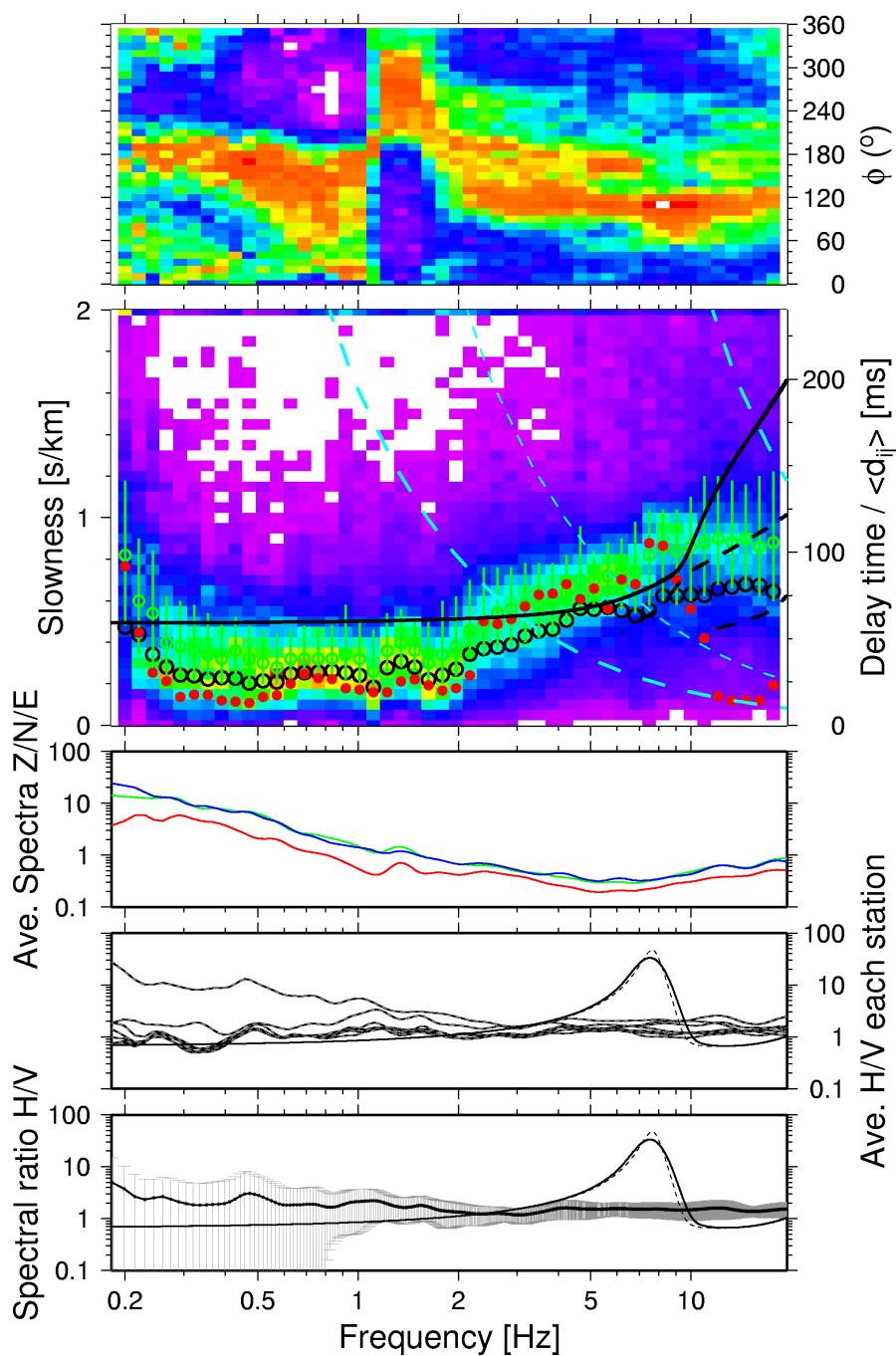
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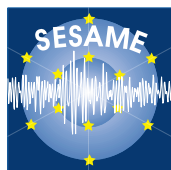
Project No: EVG1-CT-2000-00026 SESAME

Report title: Optimum deployment strategy for array measurements,
University of Potsdam, Germany,
WP05: Instrumental layout for array measurements

Deliverable No.: D07.05



D07.05 - Appendix 3 - Figure 27 Results of FK-analysis for site PRO (Volvi graben, Greece) – II.



Project Acronym: SESAME

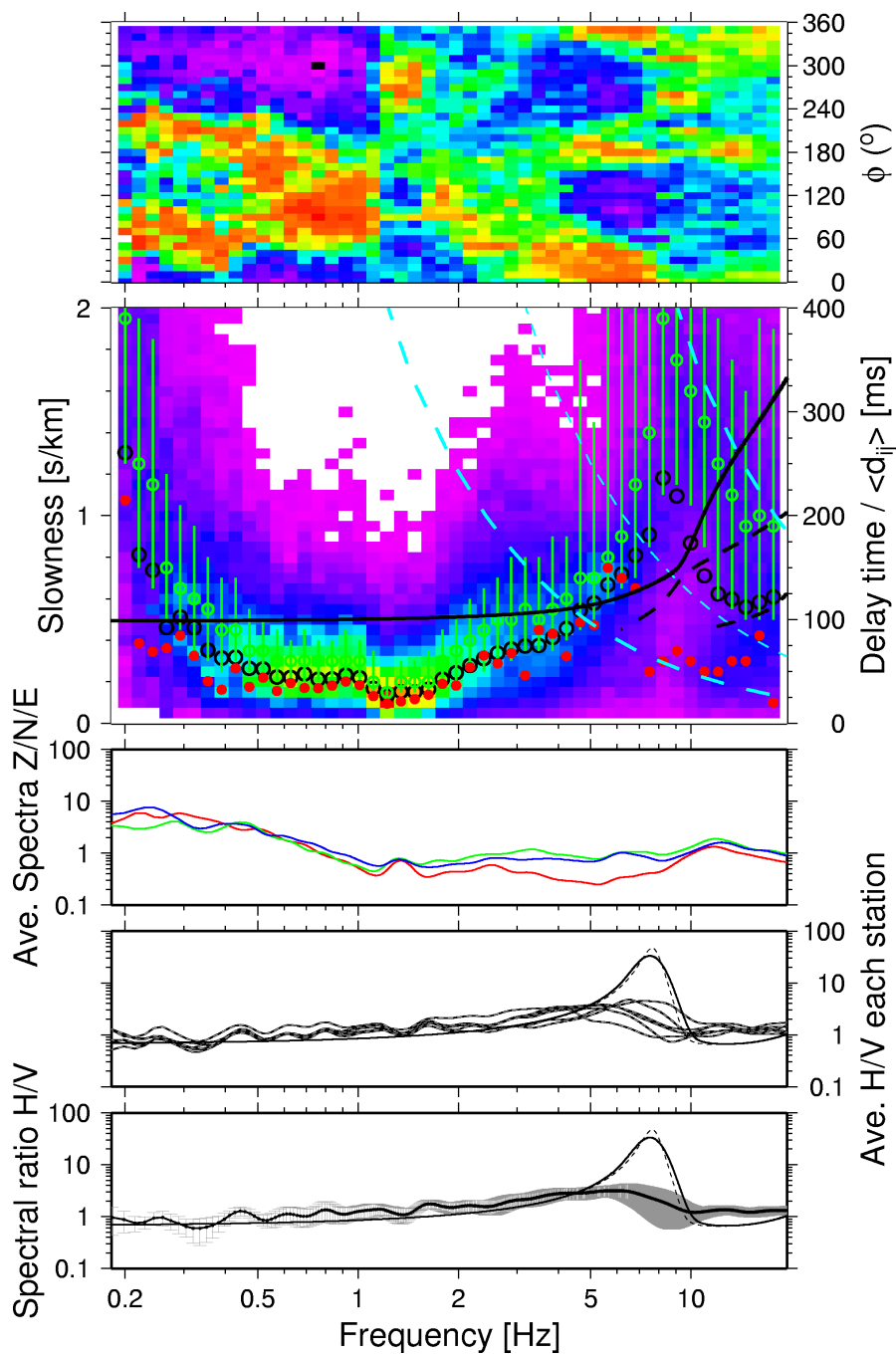
Project Title: Site Effects Assessment Using Ambient Excitations

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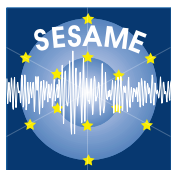
Project No: EVG1-CT-2000-00026 SESAME

Report title: Optimum deployment strategy for array measurements,
University of Potsdam, Germany,
WP05: Instrumental layout for array measurements

Deliverable No.: D07.05



D07.05 - Appendix 3 - Figure 28 Results of FK-analysis for site B7 (borehole site, Volvi graben, Greece).



Project Acronym: SESAME

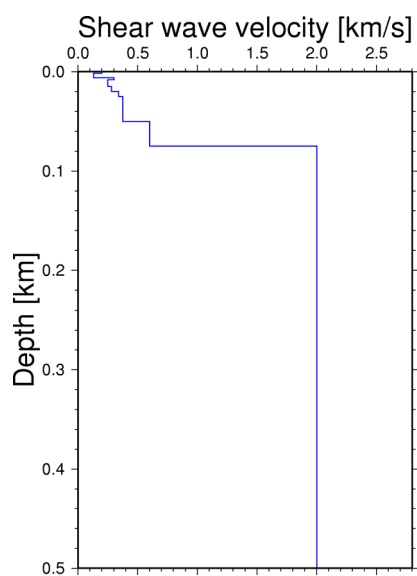
Project Title: Site Effects Assessment Using Ambient Excitations

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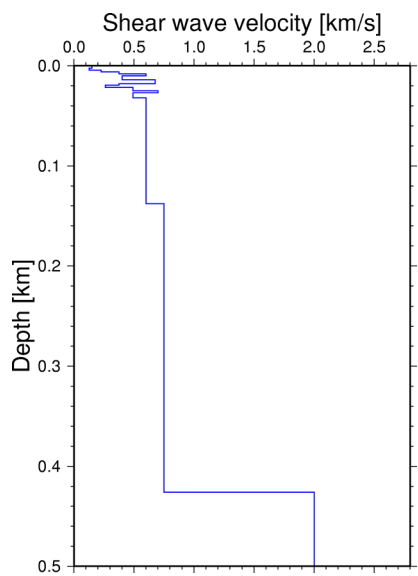
Project No: EVG1-CT-2000-00026 SESAME

**Report title: Optimum deployment strategy for array measurements,
University of Potsdam, Germany,
WP05: Instrumental layout for array measurements**

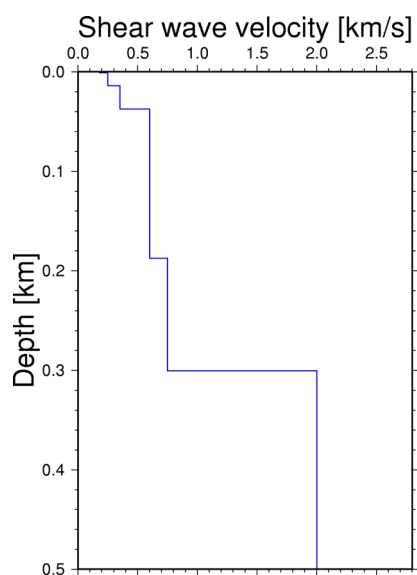
Deliverable No.: D07.05



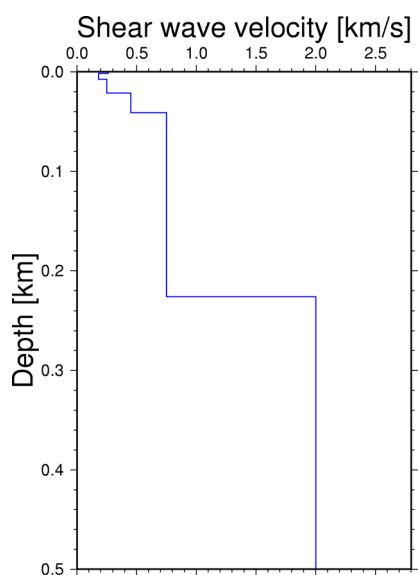
LEFKAS



KAL



VILLA



TYF

x

D07.05 - Appendix 3 - Figure 29 Shear wave velocity models for sites LEFKAS, KAL, VILLA and TYF after Anastasiadis et al., 2001.



Project Acronym: SESAME

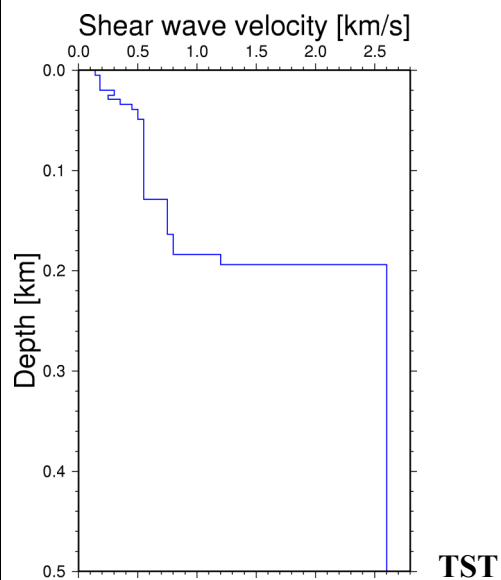
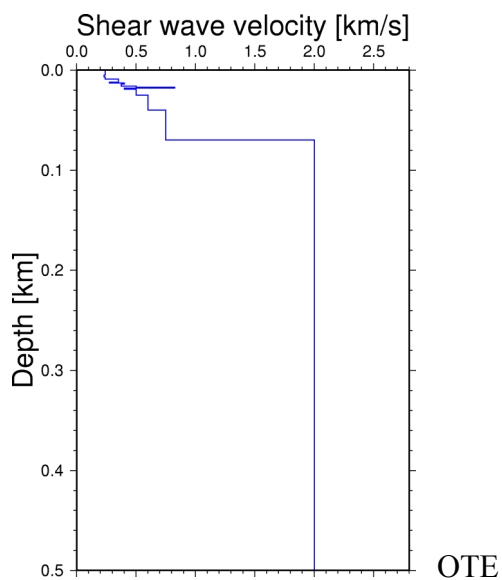
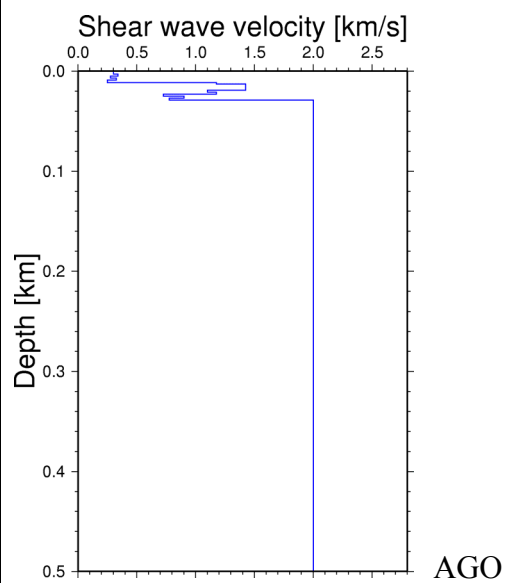
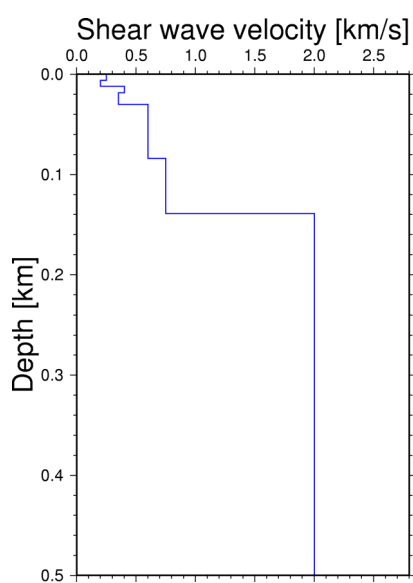
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Project No: EVG1-CT-2000-00026 SESAME

Report title: Optimum deployment strategy for array measurements,
University of Potsdam, Germany,
WP05: Instrumental layout for array measurements

Deliverable No.: D07.05



D07.05 - Appendix 3 - Figure 30 Shear wave velocity profiles for sites LEP, AGO, OTE (after Anastasiadis et al., 2001), and TST (EURO-SEISTEST, Jongmans et al., 1998).

	<p>Project Acronym: SESAME Project Title: Site Effects Assessment Using Ambient Excitations Supported by: The European Commission – Research General Directorate Project No: EVG1-CT-2000-00026 SESAME Report title: Optimum deployment strategy for array measurements, University of Potsdam, Germany, WP05: Instrumental layout for array measurements Deliverable No.: D07.05</p>
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Processing information for individual array data sets

HV-SPECTRAI RATIO ANALYSIS (Program HVDB)

The time windows and array stations which have been used for the H/V spectral ratio processing are equivalent to the time windows which have been selected for the dispersion curve analysis (see following tables for each site). Only for site Botanique the average of all time windows has been taken for the H/V displays.

Dispersion curve analysis (FK-technique, program cap)

Site		date	
BELGIUM/ LIEGE		19./20./21.03.2002	
19.03.2002			
Baviere: 3 array configurations			
Array name	Recording time	Recording stations	
1. array ('baviereA')	11:00 - 12:00 h	9 stations: P01-08A, P13A	
2. array ('baviereB')	12:45 - 14:00 h	9 stations: P01/3/4/6/7/8A, P02/5/13B	
3. array (not yet processed):	14:45 - 15:20 h	10 stations: P01/2/5/7/9/13C, P03/4/6/8A	

DISPERSION CURVE ANALYSIS (Program 'cap')			
File name	Stations	Time window	Window Length [minutes]
BaviereA = test.out1.max	P01-08A, P13A (all)	11:35:03.10- 11:38:12.71	~ 3 min
BaviereB = test.out5.max	P01/3/4/6/7/8A, P02/5/13B (all)	13:31:04.52- 13:36:45.11	~ 5.5 min

20.03.2002		
Uccle: 2 array configurations		
<i>Array name</i>	<i>Recording time</i>	Recording stations
1. array ('uccleA')	11:40 - 13:30 h	10 stations: P01-09D, P13D
2. array ('uccleB')	15:30 - 16:15 h	10 stations: P01/2/4/6/7/13E, P03/5/8/9D

DISPERSION CURVE ANALYSIS (Program 'cap')			
File name	stations	Time window	Length [minutes]
uccleA = all_uccleA.max	P01-09D, P13D (all)	11:38:12.87- 11:43:06.73	~ 6 min
		11:50:00.89- 11:55:26.74	~ 5.5 min
		13:10:01.49- 13:14:51.00	~ 5 min
		=> 16.5 min	
uccleB = all_uccleB.max	P01/2/4/6/7/13E, P03/5/8/9D (all)	15:29:16.51- 15:34:25.48	~ 9 min
		15:35:33.83- 15:39:53.31	~ 4.5 min
		15:48:49.71- 15:54:21.03	~ 5 min
		=> 18.5 min	

21.03.2002		
Botanique		
<i>Array name</i>	<i>Recording time</i>	<i>Recording stations</i>
botanique	11:00 - 12:00 h	10 stations: P01-4/6-9F, P13F

DISPERSION CURVE ANALYSIS (Program 'cap')			
File name	stations	Time window	Length [minutes]
botanique = all_botanique.max	P01-4/6-9F, P13F (all)	11:03:44.26- 11:08:27.18	~ 5 min
	P01/2/4/6/8/9/13F	11:15:05.71- 11:17:34.12	~ 2.5 min
	P01/3/4/6-9/13F	11:34:34.00- 11:39:43.85	~ 5 min
	P02-4/6-9F	11:48:20.70- 11:52:10.60	~ 4 min
			=> 16.5 min

site		date	
Weil am Rhein		09./10./11.04.2002	
9.04.2002		22 stations (E010 stops at ~12:00h, E007 starts at 12:10h and stops at ~13:50h)	
OtterbachI			
<i>Array name</i>		<i>Recording time</i>	<i>Recording stations</i>
otterbI		12:40-14:40 h	22 stations: P01F-09F,P10E,P11/12G, P13F, E002-4,7-10 (10<=>07), 13,16,19,21

DISPERSION CURVE ANALYSIS (Program 'cap')			
File name	stations	Time window	Length [minutes]
otterbI = all_otterbI.max	P04/7F,P10E,E002-4 E008-10/13/16 (11 stations)	10:58:03.00- 11:05:33.00	~ 7.5 min
	P02/4-9/13F,P10E, P11/12G,E002-4/7-9/ 13/16 (19 stations)	12:47:03.00- 12:54:24.00	~ 7.5 min
	P02-5/7-9F,P10E, P11/12G,P13F,E002- 4/7-9/13/ 16 (18 stations)	13:10:44.00- 13:26:25.00	~ 15.5 min
	P01-5/7-9F,P10E, P11/12G, E002-4/7- 9/13/16 (19 stations)	13:33:37.00- 13:43:32.00	~ 10 min
	P03-5/7-9F,P11/12G, E002-4/8/9/13/16 (15 stations)	13:54:56.00- 14:00:59.00	~ 6 min
	P02/4-6/8/9F,P10E, P11/12G,P13F,E002- 4/8/9/13/16 (17 stations)	14:14:18.00- 14:18:27.00	~ 4 min
	P02/4-6/8/9F,P10E, P11/12G, P13F,E002- 4/8/9/13 (16 stations)	14:19:19.00- 14:26:19.00	7 min
			=> 57.5 min

10.04.2002 OtterbachII		25 stations (E004 stopps at ~10:40h)
<i>Array name</i>	<i>Recording time</i>	<i>Recording stations</i>
otterbII	11:20-13:20 h	25 stations: P01F-09F,P10E,P11/12G, P13F, E002-3/7/9/10/13/14/ 16/19/21/22

DISPERSION CURVE ANALYSIS (Program 'cap')			
File name	stations	Time window	Length [minutes]
otterbII = all_otterbII.max	P01-9F,P10E, P11/12G,P13F E002/3/7/9/10/14/16 (20 stations)	11:33:42.90- 11:39:06.00	~ 6.5 min
	P01-9F,P10E, P11/12G,P13F, E002/3/7/9/13/14/16 (20 stations)	11:44:53.00- 11:56:29.00	~ 3.5 min
	P01-9,P10E, P11/12G,P13F, E002/3/7/9/13/14/16 (20 stations)	12:13:13.00- 12:20:00.00	~ 7 min
	P01-9F,P10E, P11/12G,P13F, E002/3/7/9/13/14/16 (20 stations)	12:27:06.00- 12:33:53.00	~ 7 min
	P01-9,P10E, P11/12G,P13F, E003/7/9/10/14/16 (19 stations)	12:44:16.00- 12:54:23.40	~ 10 min
	P01-9F,P10E, P11/12G,P13F, E003/7/9/10/14/16 (19 stations)	13:06:34.00- 13:14:40.00	~ 8 min
			=> 42 min

11.04.2002		
Loerrach		
<i>Array name</i>	<i>Recording time</i>	<i>Recording stations</i>
loerr	16:40-17:30 h	9 stations: P01/3/4/6/7/9F,P11/12G,P13F

DISPERSION CURVE ANALYSIS (Program 'cap')			
File name	stations	Time window	Length [minutes]
loerr = all_loerr.max	P01/3/4/6/7/9F,P11/12G,P13F (all)	16:43:34.00- 16:48:19.00	~ 5 min
		16:49:18.00- 16:53:43.00	~ 4.5 min
		16:55:40.50- 17:04:32.00	~ 9 min
		17:06:50.00- 17:10:18.00	~ 3 min
		17:15:40.00- 17:19:50.00	~ 4 min
		17:23:52.00- 17:29:16.00	~ 5.5 min
		=> 31 min	

Site		date	
ITALY/ COLFIORITO		29./30./31.07.2002	
29.07.2002			
ColfioritoA+B: two sub arrays			
BLarge: enlarged array B			
Array name	Recording time	Recording stations	
colfioritoA+B	13:00-14:00 h	12 stations each: A: GP01-4,GP06-13 B: GP05,CB02/3/5-7/10-13, G128,N200	
BLarge	15:00-15:40 h	16 stations: GP01-5,CB02/3/5-7/10-13, G128,N200	

DISPERSION CURVE ANALYSIS (Program 'cap')			
Output file name	stations	Time window	Length [minutes]
colfA & colfB: = all_colfA.max = all_colfB.max	GP01-04/06-13	13:16:00.00- 13:26:00.00	10 min
	GP05,CB02/3/5-7/10- 13,G128,N200		
	all	13:47:00.00- 13:50:00.00	3 min
		13:52:30.00- 13:55:00.00	2.5 min
			=> 15.5 min
colfBLarge = all_colfBL_40B.max	GP01-5,CB03/3/5- 7/10-13, G128,N200 (all)	15:00:30.00- 15:04:30.00	4 min
		15:10:00.00- 15:12:30.00	2.5 min
		15:21:00.00- 15:23:00.00	2 min
		15:39:30.00- 15:44:30.00	5 min
			13.5 min

30.07.2002			
ColfioritoC			
<i>Array name</i>		<i>Recording time</i>	<i>Recording stations</i>
colfioritoC		10:00-12:00 h	24 stations: GP01-13, CC01-5/7-11,CB12

DISPERSION CURVE ANALYSIS (Program 'cap')			
Output file name	stations	Time window	Length [minutes]
colfC: = all_colfC_45B.max	GP01-13,CC01-5/7-11,CB12 (all)	10:36:00.00-10:40:00.00	4 min
		10:46:00.00-10:49:00.00	3 min
		11:25:00.00-11:29:00.00	4 min
		11:50:00.00-11:54:00.00	4 min
		=> 15 min	

30./31.07.2002		
ColfioritoD+E		
<i>Array name</i>	<i>Recording time</i>	<i>Recording stations</i>
colfioritoD+E	30.07. 17:30h -31.07. 7:00 h	Each 12 stations: D: CD01-3/5-11,CC12 E: GP01-4/6-13

DISPERSION CURVE ANALYSIS (Program 'cap')			
Output file name	stations	Time window	Length [minutes]
colfD & colfE: = all_colfD.max = all_colfE.max	GP01-4/6-13 (all)	30.07.2002	
		20:06:30.00- 20:08:30.00	2 min
		21:27:30.00- 21:30:30.00	3 min
		21:55:30.00- 21:58:00.00	2.5 min
		23:57:00.00- 23:59:00.00	2 min
		31.07.2002	
		02:07:30.00- 02:10:30.00	3min
		02:24:00.00- 02:32:30.00	8.5 min
		02:33:00.00- 02:38:30.00	5.5 min
		03:32:00.00- 03:40:00.00	8 min
		04:47:30.00- 04:49:30.00	2 min
		04:51:30.00- 04:54:00.00	2.5 min
		04:55:30.00- 05:00:00.00	4.5 min
		05:00:00.00- 05:04:00.00	4 min
		06:07:30.00- 06:09:00.00	2 min
			=> 49.5 min

Site		date	
GREECE/ LEFKAS		03.08.2002	
		(02.08.2002 only GP01: 12:00 h - ...)	
3.08.2002			
Lefkas			
<i>Array name</i>	<i>Recording time</i>		<i>Recording stations</i>
Lefkas	8:20 - 11:30 h		13 stations: GP01-13

DISPERSION CURVE ANALYSIS (Program 'cap')			
Output file name	stations	Time window	Length [minutes]
lefkas = all_lefkas_40B.max	GP01-13 (all)	09:15:00.00- 09:19:00.00	4 min
		09:25:00.00- 09:28:00.00	3 min
		09:37:00.00- 09:41:00.00	4 min
		09:53:00.00- 10:00:00.00	7 min
		10:04:00.00- 10:08:00.00	4 min
		10:18:00.00- 10:22:00.00	4 min
		10:40:00.00- 10:43:00.00	3 min
			29 min

Site	date
GREECE/ THESSALONIKI	05./06./07.08.2002; six sites

<i>Array name</i>	<i>Recording time</i>	<i>Recording stations</i>
Kalamaria (KAL)	05.08.2002 7:00 - 8:00 h	13 stations: GP01-13
Villa	05.08.2002 16:30 - 17:30 h	13 stations: GP01-13
Tyf	06.08.2002 ~ 4:30 - 6:30 h	13 stations: GP01-13
Lefkos Pyrgos (lep)	06.08.2002 ~ 15:45 - 17:30 h	13 stations: GP01-13
Agora	07.08.2002 ~ 4:10 - 6:00 h	13 stations: GP01-13
Ote	07.08.2002 ~ 14:50 - 16:00 h	13 stations: GP01-13

DISPERSION CURVE ANALYSIS (Program 'cap')			
Output file name	stations	Time window	Length [minutes]
KAL = all_KAL_40B.max	GP01-13 (all)	07:00:00.00- 07:03:00.00	3 min
		07:23:30.00- 07:25:30.00	2 min
		07:47:00.00- 07:49:00.00	2 min
		07:50:00.00- 07:53:00.00	3 min
	GP01-3/5-13	08:00:00.00- 08:02:00.00	2 min
villa = all_villa_40B.max	GP01-13 (all)	17:02:30.00- 17:06:30.00	4 min
		17:20:00.00- 17:22:30.00	2.5 min
		17:23:00.00- 17:25:00.00	2 min

tyf = all_tyf_40B.max	GP01-13 (all)	05:03:30.00- 05:06:30.00	3 min
		05:15:00.00- 05:17:30.00	2.5 min
		05:26:30.00- 05:29:00.00	2.5 min
		05:42:00.00- 05:44:00.00	2 min
		05:47:30.00- 05:49:30.00	2 min
			12 min
lep = all_lep_40B.max	GP01-13 (all)	16:08:00.00- 16:13:00.00	5 min
		16:20:00.00- 16:25:00.00	5 min
		16:32:00.00- 16:37:00.00	5 min
			15 min
agora = all_agora(-a).max	GP01-13 (all) GP01-08	04:30:00.00- 04:34:00.00	4 min
		05:00:00.00- 05:04:00.00	4 min
		05:30:00.00- 05:33.30.00	3.5 min
		05:35:00.00- 05:37:00.00	2 min
		05:50:00.00- 05:54:00.00	4 min
			17.5 min
ote = all_ote.max	GP01-13 (all)	15:03:30.00- 15:07:00.00	3.5 min
		15:17:00.00- 15:20:00.00	3 min
		15:35:30.00- 15:37.30.00	2 min
		15:45:00.00- 15:49:00.00	4 min
			12.5 min

Site	date
GREECE / VOLVI	08./ 09.08.2002
	five array geometries

8.08.2002	Three array geometries	
Euro-Seistest		
Array name	Recording time	Recording stations
tst1	7:00 - 8:00 h	13 stations: GP01-13
tst2	8:50 - 10:00 h	13 stations: GP01-09,GP14-17
tst3 (two arrays) GP GA (greenhouse)	11:00 - 13:00 h	7 stations: GP01,03-08 6 stations: GA02,09-13

DISPERSION CURVE ANALYSIS (Program 'cap')			
File name	stations	Time window	Length [minutes]
tst1 = all_tst1_40B.max	GP01-13	07:33:00.00-	2 min
	(all)	07:35:00.00	
	GP01,GP03-13	07:40:00.00-	2 min
		07:42:00.00	
	all	07:57:30.00-	2 min
		07:59:30.00	
			6 min
tst2 = all_tst2_40B.max	GP01-09,GP14-17	08:54:30.00-	5.5 min
	(all)	09:00:00.00	
		09:00:00.00-	3 min
		09:03:00.00	
		09:32:00.00-	3 min
		09:35:00.00	
			11.5 min

tst3 = all_tst3_GP.max = all_tst3_GA.max	GP01,GP03-08 GA02,GA09-13	11:23:30.00- 11:29:30.00	6 min
		11:36:30.00- 11:46:30.00	10 min
		11:56:30.00- 11:59:30.00	3 min
		12:01:00.00- 12:04:00.00	3 min
		12:12:00.00- 12:15:30.00	3.5 min
		12:25:00.00- 12:30:00.00	5 min
		30.5 min	

9.08.2002		Two array geometries	
Profitis			
Array name	Recording time	Recording stations	
pro1	6:30 - 8:00 h	13 stations: GP01-13	
pro2 (two arrays) GP B7	9:00 - 10:00 h	7 stations: GP01/4/7/8/11-13 6 stations: B702/3/5/6/8/10	

DISPERSION CURVE ANALYSIS (Program 'cap')			
File name	stations	Time window	Length [minutes]
pro1 = all_pro1_48B.max	GP01-13 (all)	06:30:30.00- 06:34:30.00	4 min
		06:40:00.00- 06:42:30.00	2.5 min
		06:49:05.00- 06:52:05.00	3 min
		07:00:00.00- 07:02:30.00	2.5 min
		07:55:30.00- 07:57:30.00	2 min
pro2 = all_pro2GP_48B.max = all_pro2B7_48B.max	GP01/4/7/8/11-13 B702/3/5/6/9/10	09:12:30.00- 09:15:30.00	3 min
		09:19:00.00- 09:24:00.00	5 min
		09:49:30.00- 09:52:00.00	2.5 min
		09:52:30.00- 09:55:00.00	2.5 min

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Jongmans, D., Pitilakis, K., Demanet, D., Raptakis, D., Riepl, J., Horrent, C., Tsokas, G., Lontzetidis, K., and Bard, P.-Y., EURO-SEISTEST: Determination of the geological structure of the Volvi graben and validation of the basin response, Bulletin of the Seismological Society of America, Vol. 88, pp. 473-487, 1998.