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D.2.2-8 HE-E annual monitoring report

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PEBS





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Mont Terri
PEBS: HE-E Experiment

Monitoring and maintenance

D.2.2-8 HE-E annual monitoring report

Monitoring period: 01/03/12 – 28/02/13

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1 INTRODUCTION

According to the DOW “description of work” Task 2.2 of the PEBS grant agreement, Solexperts is responsible for the monitoring and maintenance of the experiment HE-E as part of the PEBS project.

The HE-E Experiment is performed in the 50 m long microtunnel which has a diameter of 1.3 m. The 10 m test section of the microtunnel was characterised in detail during the Ventilation (VE) Experiment (Figure 1). Table 1 shows the task overview for the project identification and responsibility partners.

A series of annual monitoring reports is planned to document the data set recorded by the HE-E data acquisition system (DAS). In addition, the monitoring reports summarise the site activities, indicate DAS incidents and describe the measurements taken to guarantee a proper function of the DAS and the corresponding sensors. The first monitoring report describes the period between 1st March 2011 and 28th February 2012 (Grava et al., 2012).

This monitoring report covers the period between 1st March 2012 and 28th February 2013.

To monitor the engineered barrier system (EBS) and host rock behaviour during the HE-E Experiment, specific sensors were installed in three main zones and can therefore be divided in three different groups: (1) The engineered barrier system (EBS) and EBS/host rock interface, (2) the Opalinus clay host rock in the microtunnel sections and (3) the Opalinus Clay host rock in boreholes drilled from the Gallery 98. The monitoring of the two heater elements is not included in this report as the sensors are connected to another data acquisition system.

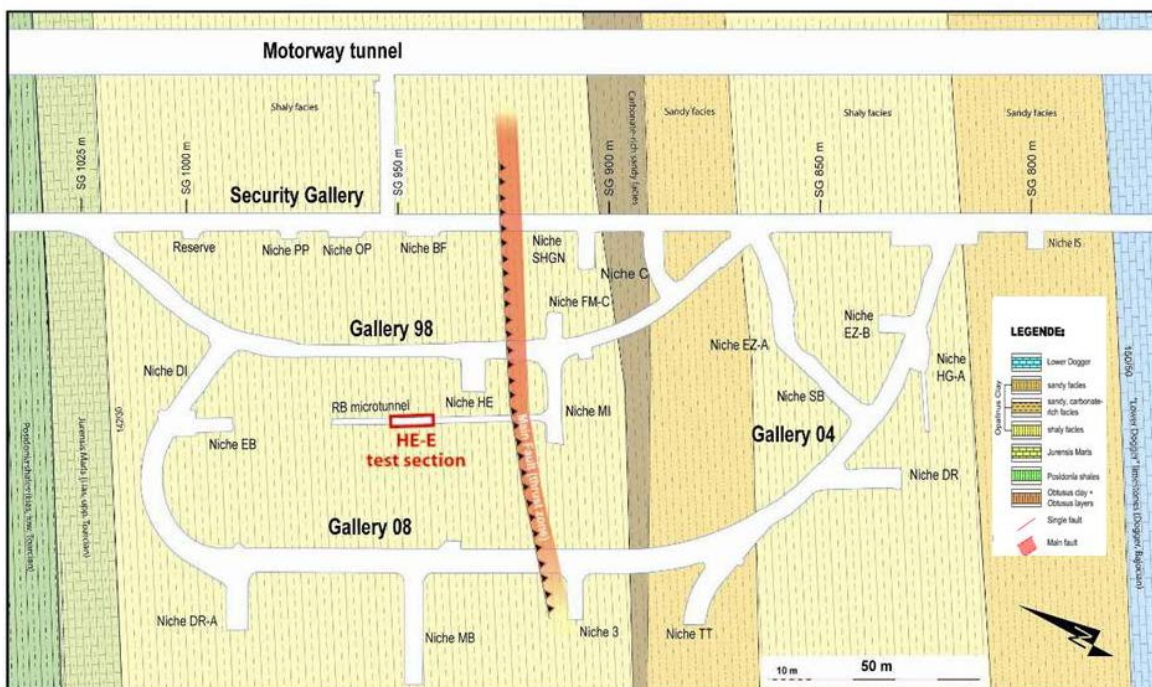


Figure 1: Location of the HE-E test section in the Mont Terri rock laboratory

DAS related work is described in Chapter 3. The field activity logbook and the data acquisition logbook are included in Appendix A. A list with all the sensors and their specifications and the schematic drawings of the sensor locations are included in Appendix B. The graphs of the measurements are shown in Appendices C, D and E.

Table 1: Task Overview

Project Identification	PEBS: HE-E
Experiment Task	HE-E annual monitoring report
Reference Document	DOW "description of work" Task 2.2 of the PEBS grant agreement"
Responsibilities	Project Manager: Irina Gaus, Nagra Deputy: Paul Marschall, Nagra Reporting: Kirsten Gräfe, Solexperts Manager master-database: Ursula Rösli, Solexperts

2 FIELD ACTIVITIES

The construction and instrumentation works took place between January and May 2011. The experiment layout is described in detail in the as-built report (Teodori S. & Gaus I., 2012).

The main field activities during the monitoring period are summarized in Table 2. The detailed field activity logbook is included in Appendix A.

Table 2: Main field activities

Date	Activity	Observation
02.02.2012	Check ADAM module 2 Slot 2 and connected sensors	
08.02.2012	Defective fuse in psychrometer, unit replaced	
27.03.2012	Check sensors Ch.321 T-G1-9H/ Ch.367 T-G3-9H	Sensors defective
08.05.2012	Identification and description of interfaces at HE project	
22.05.2012	Removal of CR7 logger for repair (Aitemin)	
11.06.2012	Disconnect sensors T/HC-G1-9H and T/HC-G3-9H	
08.08.2012	Reconnaissance	
16.10.2012	Checking loose cables at Ch.55; sensor still shows unstable values	

3 DATA ACQUISITION SYSTEM (DAS)

The data acquisition system (DAS) worked fine for the monitoring period. During instrumentation, all sensors of the previous VE Experiment were connected to the DAS of the HE-E Experiment. However, several sensor signals were already erroneous during the last observation period of the VE Experiment. To check the performance of these sensors, they were also connected to the HE-E DAS. Most of these sensors proved to be defective and were disconnected after the end of the instrumentation.

The CR7 logger showed repeated failures during the monitoring period. Between 1st December 2011 and 27th February 2012, 09th and 22nd March, 30th March and 2nd April and 30th April and 8th May 2012, no data are recorded for the psychrometers. Therefore, the CR7 logger was removed on 22nd May 2012 and brought to Aitemin for repair.

Table 3 summarises the main DAS problems and the defective sensors. A detailed DAS logbook with all sensor malfunctions, failures or removals is shown in Appendix A. A list with all sensors and their status at the end of the monitoring period is given in Appendix B.

Table 3: DAS interruptions and defective sensors

Date	Sensor name and type		Section	Events
01.12.2011–27.02.2012 09.03.–22.03.2012 30.03.–02.04.2012 30.04.–08.05.2012 Since 22.05.2012	Psychro- meters 1-25	Humidity	SB1 and SB2	No connection to CR7 logger, mostly no data CR7 logger removed for repair, no data
28.02.-14.08.2012	P-B78	Pressure	SA1	Noisy measurements
Since 28.02.2012	T-G3-9H	Temperature	GRS carrier 3	Defective
Since 20.03.2012	T-G1-9H	Temperature	GRS carrier 1	Defective
29.03.2011-08.03.2012	P-B6	Pressure	SA4	Noisy measurements
Since 05.05.2011	P-BE2-I4	Pressure	BHE-E2	Noisy measurements
Since 18.05.2012 08.07.-22.07.2012 Since 28.09.2012	P-BE2-P2	Packer pressure	Gallery 98	Sudden decrease (reason unknown) Noisy Noisy and defective
Since 11.06.2012	HC-G3-9H	Humidity	GRS carrier 3	Defective
Since 11.06.2012	HC-G1-9H	Humidity	GRS carrier 1	Defective
Since 14.07.2012	T-G2-3H	Temperature	GRS carrier 2	Defective
Since 17.07.2012	HC-SB1	Humidity	SB1	Defective
Since 25.07.2012	P-B40	Pressure	SA3	Repeated error measurements
Since 25.07.2012	P-B41	Pressure	SA3	Occasionally noisy data
Since 17.09.2012	T-B49	Temperature	SD1	Defective
17.09.-04.11.2012	T-B16	Temperature	SB2	Error measurements
16.09.- 04.10.2012 17.09.12-09.12.2012	T-B48	Temperature	SD1	Error measurements Noisy measurements
Since 03.10.2012	T-BESA21	Temperature	SA20	Repeated error measurements
22.10.12-25.01.2013	HC-B12	Humidity	SB2	Error measurements
Since 06.11.2012	HC-B71	Humidity	SB1	Defective
Since 09.11.2012	HC-B14	Humidity	SB2	Defective
Since 04.12.2012	HC-B23	Humidity	SB2	Defective
Since 10.12.2012	T-G1-12H	Temperature	GRS carrier 1	Defective
Since 12.02.2013	HC-B64	Humidity	SB1	Defective
Since 10.01.2013	HC-B20	Humidity	SB2	Defective

4 SENSORS IN MICROTUNNEL SECTIONS

Six sections perpendiculars to the microtunnel axis are equipped with 24 Mini-Piezometer systems, humidity sensors, temperature sensors and extensometers. A great part of these sensors were already installed during the previous VE Experiment. The instrumentation is described in detail in the as-built report (Teodori & Gaus, 2012). An overview of the sections relative to the tunnel and their layouts are included in Appendix B.

4.1 PORE PRESSURE AND TEMPERATURE MEASUREMENTS IN SECTIONS SA1 TO SA4, SA20 AND SD20

The Mini-Piezometers in section SA1, SA2, SA3 and SA4 were installed during the VE Experiment. The two sections SA20 and SD20 were equipped in the framework of the HE-E Experiment.

4.1.1 Section SA1

The corresponding data plot is included in Appendix C1. The pressure sensors in section SA1 reflected atmospheric conditions or suction below atmospheric pressure at the start of the monitoring period. The pressure measured by sensor P-B79 was continuously increasing to a final pressure of about 124 kPa. The pressure measured by sensor P-B78 was continuously increasing since July 2012 with a steep increase starting on the 6th February 2013 and a pressure peak of about 224 kPa on 23rd February 2013.

4.1.2 Section SA2

The corresponding data plot is included in Appendix C2. The pressure sensors in section SA2 with the exception of P-B55, P-B56 and P-B62 reflected atmospheric conditions or suction below atmospheric pressure at the start of the monitoring period. The pressures measured for the sensors P-B55, P-B56 and P-B62 showed steadily increasing values to maximum pressures between 700 and 1000 kPa until January 2013 followed by a pressure decrease due to the heater failure. Sensor P-B60 started to slightly increase in August 2012. The pressures recorded for the other pressure sensors remained mostly constant.

4.1.3 Section SA3

The corresponding data plot is included in Appendix C3. The pressures of all sensors were increasing to pressure between about 400 and 800 kPa until January 2013, followed by a decrease due to heater failure. Sensor P-B40 showed noisy/error measurements from the 25th July 2012 onwards. Sensor P-B41 occasionally showed slightly noisy values until the 29th July 2012.

4.1.4 Section SA4

The corresponding data plot is included in Appendix C4. Except for sensor P-B7 the pressure sensors in section SA4 reflected atmospheric conditions. The pressure measured for P-B7 continuously increased until the 25th January 2013 followed by pressure variations related to the heater failure.

4.1.5 Section SA20

These sensors are located in section SA2 (see Appendix B). The corresponding data plot is included in Appendix C5. The pressure sensors in section SA20 reflected atmospheric conditions. At the beginning of the monitoring period, sensor P-BESA23 measured pressure slightly higher than

atmospheric pressures with a decreasing trend and stabilised at atmospheric pressure since the 29th April 2012.

The measured temperatures reflected the temperature changes of the heater with a maximum temperature of about 40 °C (T-BESA25).

4.1.6 Section SD20

These sensors are located in section SD2 (see Appendix B). The corresponding data plot is included in Appendix C6. Except for sensor P-BESD24 which showed suction below atmospheric pressure all pressure sensors in section SA20 reflected atmospheric conditions. The pressure measured with sensor P-BESD24 increased from about 85 kPa to 99 kPa on the 28th December 2013 and then stabilized at about atmospheric pressure (T-BESD25).

The temperatures reflected the temperature changes of the heater with a maximum temperature of about 38 °C.

4.2 ROCK DISPLACEMENT SENSORS INCLUDING TEMPERATURE MEASUREMENTS

The Solexperts displacement sensors (mini-extensometers) including temperature measurements were installed in sections SD1 and SD2 during the VE Experiment.

4.2.1 Section SD1

The corresponding data plot is included in Appendix C7. Sensor values of rock displacement decreased from the start of the observation period to the 26th July 2012 and then increased slightly. On the 30th September measurements dropped to lower values and stabilized. A decrease in the measurements means that the distance between the anchor at the deepest part of the borehole and the measuring head increased. The temperatures reflected the temperature changes of the heater with a maximum temperature of about 40 °C. Temperature sensor T-B49 became defective on the 16th September 2012. Temperature sensor T-B48 showed noisy measurements between the 16th September and the 9th December 2012. Afterwards the measurements stabilised again with slight variations since end of January 2013 due to temperature changes in the heaters.

4.2.2 Section SD2

The corresponding data plot is included in Appendix C8. Sensor values of rock displacement decreased from the start of the observation period to the 26th July 2012 and then increased slightly. On the 30th September measurements dropped to lower values and stabilized. A decrease in the measurements means that the distance between the anchor at the deepest part of the borehole and the measuring head increased.

The temperatures reflected the temperature changes of the heater with a maximum temperature of about 92 °C (T-B25).

4.3 ROCK WATER CONTENT MEASUREMENTS

The capacitive relative humidity and temperature sensors and the psychrometers were installed in boreholes in the profiles SB1 and SB2 during the VE Experiment.

4.3.1 Capacitive Sensors including Temperature in Section SB1

The corresponding data plot is included in Appendix C9. Sensors HC-B71 (since 06.11.2012) and HC-SB1 (since 17.07.2012) were found to be defective during the monitoring period (Table 3, Appendix A). The measured relative humidity values of sensors HC-B64, HC-B66, HC-B73, HC-B71 and HC-SB1 were constant above 99%.

The temperatures reflected the temperature changes of the heater with a maximum temperature of about 42 °C (T-SB1).

4.3.2 Capacitive Sensors including Temperature in Section SB2

The corresponding data plot is included in Appendix C10. HC-B14 and HC-B23 were found to be defective during the monitoring period. The values of the relative humidity sensors near the EBS/host rock interface, HC-B93, HC-B94, HC-B95 and HC-B92 increased until they reached 100 % and remained constant at this value until the end of the observation period. The measured relative humidity values for sensor HC-B20 were at 100 % throughout the observation period. Sensor HC-B12 measured relative humidities of over 98 % until the 21st October and then again from the 25th January onwards. Between these dates the sensor measurements were erroneous.

The temperatures reflected the temperature changes of the heater with a maximum temperature of about 42 °C (T-SB2).

4.3.3 Psychrometers in Section SB1

The corresponding data plot is included in Appendix C11. All sensors of Section SB1 gave erroneous or no measurements during the entire monitoring period.

4.3.4 Psychrometers in Section SB2

The corresponding data plot is included in Appendix C11. All sensors of Section SB2 gave erroneous or no measurements except for sensors HC-B19 and HC-B21 which provided valid data until the 22nd May 2012 with periods of no measurements between the 9th and the 22nd March, between the 30th March and the 2nd April and between the 30th April and the 8th May 2012. The measured relative humidity changed only slightly during the measuring period.

4.4 PORE PRESSURE MEASUREMENTS IN THE BOREHOLES FROM THE GALLERY GA98

4 multi-packer systems were installed from Gallery 98 for far-field pore pressure measurements. Borehole BVE-1 and BVE-91 were drilled and equipped with a triple and a quadruple packer system during the VE Experiment. Boreholes BHE-E1 was installed on 30th March 2011 and borehole BHE-E2 on 4th May 2011, both equipped with a quadruple packer system. An overview of the borehole instrumentation is shown in Appendix B. Data plots are included in Appendices D1 to D4.

Generally, most pressure data of interval and packer pressures show a continuous increase until January 2013 and a decrease or variations in the measurements until the end of the monitoring period related to the failures of the heaters.

In borehole BHE-E1, the pressure sensors for the packers and intervals worked fine during the entire monitoring period. A small decrease in the measurements of sensor P-BE1-I3 can be observed on the 18th May 2012, which might be related to the problems with the packer pressure in borehole BHE-E2. The interval pressure sensor P-BE1-I1 showed constant pressure values which reflected

atmospheric pressures until the 5th July 2012 and then the pressure started to increase until the end of the monitoring period.

The packer and interval pressure sensors of borehole BHE-E2 worked fine except for pressure sensor P-BE2-I4 which gave noisy measurements throughout the observation period, and the packer pressure sensor P-BE2-P2 which suddenly decreased on 18th May 2012 and started to give erroneous measurements since 28th September 2012. The decrease on the 18th May caused a minor pressure decrease in the adjoining intervals P-BE2-I2 and P-BE2-I3 (and additionally in P-BE1-I3). Since the 1st December 2012, pressure variations can be observed in the interval pressures which might also be related to the problems of the packer pressure P-BE2-P2.

The interval pressures of the packer systems installed during the VE experiment (BVE-1 and BVE-91) worked fine during the entire monitoring period.

5 SENSORS IN THE EBS AND THE EBS/HOST ROCK INTERFACE

The EBS and the host rock/EBS interface were instrumented with temperature and relative humidity sensors. An overview of sensor locations is shown in Appendix B and data plots are in Appendices E1 to E6.

Most of the sensors worked fine for the entire monitoring period except for the following sensors which were found to be defective: T-G1-12H, T-G2-3H, T-G3-9H, HC-G1-9H and HC-G3-9H.

The sensors T-G3-R, HC-G3-R, T-N1-R and HC-N1-R are installed inside the railroad under the plug. Therefore, the measurements represent the climatic conditions of the cable channel.

The temperatures reflected the temperature changes of the heater. In general, the temperatures increased until July and then stayed constant until the end of the monitoring period. On three occasions, on the 29th August 2012, the 20th January 2013 and then 7th February 2013 the temperature values show a sudden decrease related to the failures of the heater (see Chapter 6)

The humidity at middle and centre positions and within the bentonite blocks decreased steadily during the monitoring period, whereas the humidity at the EBS-host rock interface was already 100 % at the start of the monitoring period or increased to 100 % humidity during the monitoring period (except for HC-N3-9H and HC-N1-3H). Sensor HC-G1-3H is at 100 % humidity for the entire observation period except for the two periods of power failure of the heater. All relative humidity sensors measuring 100 % humidity are noted in Appendix B.

6 SUMMARY

The measurements in the microtunnel sections mostly show a correlation with the temperature in the heaters. During the monitoring period, the heater temperature increased from about 110 °C at the start of the monitoring period to temperatures between 130 and 140 °C on the 1st July 2012. Since then, the temperatures remained constant except for three power failures at the heaters, the first between the 28th and the 30th August 2012, the second between the 19th and the 23rd January 2013 and the third between the 6th and the 8th February 2013. The first failure only caused a small temperature decrease with a small impact on the measurements. However, the second and the third temperature decreases were more pronounced and caused distinct variations in the measurements, especially of the pressure sensors.

7 REFERENCES

Grava, E., Achtziger, P. & Rösli, U. (2012): PEBS: Deliverable (D-N°:2.2-8) D.2.2-8 HE-E annual monitoring report.

Rösli U. (2010): Mont Terri Project: VE experiment long term monitoring data report phase 15. TN 2010-12.

Teodori S.P. & Gaus I. (2012): PEBS: Deliverable (D-N°: 2.2-3) Report of the construction of the HE-E experiment.

Appendix A:

- *Data acquisition logbook*
- *Field activity logbook*

Data Acquisition Logbook

DATE AND TIME	SENSOR	GEO-MONITOR CH.	BOREHOLE/SECTION	TYPE	ACTIONS/PROBLEMS
Status 28.02.2012	HC-B75 HC-B69 HC-B77	87 111 105	SB1	Humidity	Defective
	RD-B48	79	SD1	Displacement	Defective
	T-B46	125	SD1	Temperature	Defective
	RD-B27	75	SD2	Displacement	Defective
	T-B26	122	SD2	Temperature	Defective
	T-B27	123	SD2	Temperature	Noisy measurements
	T-B47	126	SD1	Temperature	Noisy measurements
	Long green	Psychro-18	n/a	Psychrometer	No measurements
	HC-B65 HC-B68 HC-B74 HC-B76 HC-B63 HC-B67	Psychro-09 Psychro-22 Psychro-13 Psychro-25 Psychro-17 Psychro-11	SB1	Psychrometer	No measurements
	HC-B11 HC-B13 HC-B17 HC-B22 HC-B24	Psychro-01 Psychro-02 Psychro-03 Psychro-21 Psychro-08	SB2	Psychrometer	No measurements
	Short green	Psychro-23	n/a	Psychrometer	No measurements
	T-B23	98	SB2	Temperature	Defective
	P-BE2-P3	56	BHE-E2	Pressure	Defective
	HC-N3-5BI	278	Nagra Carrier 3	Humidity	Defective
	T-N3-5BI	279	Nagra Carrier 3	Temperature	Defective
	HC-B18	85	SB2	Humidity	Defective
T-B18	86	SB2	Temperature	Defective	
01.12.2011–27.02.2012 09.03.–22.03.2012 30.03.-02.04.2012 30.04.-08.05.2012 Since 22.05.2012	Psychro-meters 1-25		SB1 and SB2	Humidity	No connection to CR-7 logger, mostly no data CR7 logger removed for repair, no data
28.02.-14.08.2012	P-B78	25	SA1	Pressure	Noisy measurements
Since 28.02.2012	T-G3-9H	367	GRS carrier 3	Temperature	Defective
Since 20.03.2012	T-G1-9H	321	GRS carrier 1	Temperature	Defective
29.03.2011-08.03.2012	P-B6	9	SA4	Pressure	Noisy measurements

DATE AND TIME	SENSOR	GEO-MONITOR CH.	BOREHOLE/SECTION	TYPE	ACTIONS/PROBLEMS
Since 05.05.2011	P-BE2-I4	45	BHE-E2	Pressure	Noisy measurements
Since 18.05.2012	P-BE2-P2	55	Gallery 98	Pressure	Defective
Since 11.06.2012	HC-G3-9H	366	GRS carrier 3	Humidity	Defective
Since 11.06.2012	HC-G1-9H	320	GRS carrier 1	Humidity	Defective
Since 14.07.2012	T-G2-3H	359	GRS carrier 2	Temperature	Defective
Since 17.07.2012	HC-SB1	99	SB1	Humidity	Defective
Since 25.07.2012	P-B40	23	SA3	Pressure	Repeated error measurements
Since 25.07.2012	P-B41	24	SA3	Pressure	Occasionally noisy data
Since 17.09.2012	T-B49	128	SD1	Temperature	Defective
17.09.-04.11.2012	T-B16	90	SB2	Temperature	Error measurements
16.09.- 04.10.2012 17.09.12-09.12.2012	T-B48	127	SD1	Temperature	Error measurements Noisy measurements
Since 03.10.2012	T-BESA21	129	SA20	Temperature	Repeated error measurements
22.10.12-25.01.2013	HC-B12	91	SB2	Humidity	Error measurements
Since 06.11.2012	HC-B71	103	SB1	Humidity	Defective
Since 09.11.2012	HC-B14	93	SB2	Humidity	Defective
Since 04.12.2012	HC-B23	97	SB2	Humidity	Defective
Since 10.12.2012	T-G1-12H	316	GRS carrier 1	Temperature	Defective
Since 12.02.2013	HC-B64	109	SB1	Humidity	Defective
Since 10.01.2013	HC-B20	81	SB2	Humidity	Defective

Field Activity Logbook

DATE	TIME	WHO	ACTIVITY
02.02.12		RL	Check ADAM module 2 Slot 2 and connected sensors
27.03.12		MV	Check sensors CH321/367
08.05.12	12:20	MV	Identification and description of Interfaces at HE project.
22.05.12	15:00	Aitemin	Removal of CR7 logger for repair
11.06.12	12:30-13:00	PA	Disconnect sensors T/HC-G1-9H and T/HC-G3-9H
08.08.12	15:15-15:30	MV	Reconnaissance
16.10.12	14:30-14:45	MV	Checking loose cables at channel #55. Sensor still shows unstable values

Abbreviations:

PA: Peter Achtziger (engineer)
 MV: Miroslav Vrzba (engineer)
 RL: Roland Leu (electrician)

Appendix B:

- *List of sensors for the HE-E Experiment*
- *Sensor locations*

INTERFACE Sensor assembling box	DAS - Channel	Borehole	Sensor name	Unit	Depth [m]	Range	Sensor type	Output signal	Sensor SN	Status 28.02.2013	Profile	Atmos- pheric pressure
n/a	1	BVE-1	P-B1-13m	kPa	13.00	100-2100	PAA-23	4-20mA			Gallery 98	
	2		P-B1-11m	kPa	11.00	100-2100	PAA-23	4-20mA			Gallery 98	
	3		P-B1-09m	kPa	9.00	100-2100	PAA-23	4-20mA			Gallery 98	
	4		P-B1-07m	kPa	7.00	100-2100	PAA-23	4-20mA			Gallery 98	
SA4	5	BVE-2	P-B2	kPa	1.55	0-2000	PAA-23	4-20mA	42183		SA4	88.2
	6	BVE-3	P-B3	kPa	1.04	0-2000	PAA-23	4-20mA	42194		SA4	92.8
	7	BVE-4	P-B4	kPa	1.05	0-2000	PAA-23	4-20mA	42172		SA4	102.2
	8	BVE-5	P-B5	kPa	0.55	0-2000	PAA-23	4-20mA	42180		SA4	92.6
	9	BVE-6	P-B6	kPa	1.63	0-2000	PAA-23	4-20mA	42181	Noisy	SA4	119.0
	10	BVE-7	P-B7	kPa	2.06	0-2000	PAA-23	4-20mA	42182		SA4	97.3
	11	BVE-8	P-B8	kPa	0.50	0-2000	PAA-23	4-20mA	42188		SA4	92.2
	12	BVE-9	P-B9	kPa	1.40	0-2000	PAA-23	4-20mA	42196		SA2	92.4
SA2	13	BVE-55	P-B55	kPa	2.11	0-2000	PAA-23	4-20mA	42169		SA2	94.3
	14	BVE-56	P-B56	kPa	2.11	0-2000	PAA-23	4-20mA	42167		SA2	93.7
	15	BVE-57	P-B57	kPa	1.80	0-2000	PAA-23	4-20mA	?		SA2	97.9
	16	BVE-58	P-B58	kPa	1.12	0-2000	PAA-23	4-20mA	42184		SA2	98.1
	17	BVE-59	P-B59	kPa	2.12	0-2000	PAA-23	4-20mA	42193		SA2	101.2
	18	BVE-60	P-B60	kPa	1.50	0-2000	PAA-23	4-20mA	42170		SA2	95.3
	19	BVE-61	P-B61	kPa	1.80	0-2000	PAA-23	4-20mA	42185		SA2	95.3
	20	BVE-62	P-B62	kPa	2.13	0-2000	PAA-23	4-20mA	42195		SA2	93.5
SA1&SA3	21	BVE-38	P-B38	kPa	2.10	0-2000	PAA-23	4-20mA	42191		SA3	93.5
	22	BVE-39	P-B39	kPa	2.11	0-2000	PAA-23	4-20mA	42176		SA3	93.5
	23	BVE-40	P-B40	kPa	1.80	0-2000	PAA-23	4-20mA	42177	Occasionally noisy	SA3	95.2
	24	BVE-41	P-B41	kPa	1.81	0-2000	PAA-23	4-20mA	42187	Occasionally noisy	SA3	98.8
	25	BVE-78	P-B78	kPa	2.10	0-2000	PAA-23	4-20mA	42173	Occasionally noisy	SA1	93.6
	26	BVE-79	P-B79	kPa	2.10	0-2000	PAA-23	4-20mA	42175		SA1	84.6
	27	BVE-80	P-B80	kPa	1.81	0-2000	PAA-23	4-20mA	42192 (?)		SA1	96.1

INTERFACE Sensor assembling box	DAS - Channel	Borehole	Sensor name	Unit	Depth [m]	Range	Sensor type	Output signal	Sensor SN	Status 28.02.2013	Profile	Atmos- pheric pressure
	28	BVE-81	P-B81	kPa	1.80	0-2000	PAA-23	4-20mA	42189 (?)		SA1	93.6
421038.182	29	BVE-91	P-B91-10m	kPa	10.00	0-3000	PAA-33X	4-20mA	65014		Gallery 98	108.3
	30		P-B91-08m	kPa	8.82	0-3000	PAA-33X	4-20mA	65269		Gallery 98	100.2
	31		P-B91-07m	kPa	7.66	0-3000	PAA-33X	4-20mA	47458		Gallery 98	109.4
n/a	32	BHE-ESA21	P-BESA21	kPa	0.60	0-5000	PAA-23X	4-20mA	146519		SA20	92.4
n/a	33	BHE-ESA22	P-BESA22	kPa	1.00	0-5000	PAA-23X	4-20mA	146520		SA20	92.0
n/a	34	BHE-ESA23	P-BESA23	kPa	0.60	0-5000	PAA-23X	4-20mA	146521		SA20	92.0
n/a	35	BHE-ESA24	P-BESA24	kPa	1.00	0-5000	PAA-23X	4-20mA	146522		SA20	92.0
n/a	36	BHE-ESA25	P-BESA25	kPa	0.30	0-5000	PAA-23X	4-20mA	146523		SA20	92.0
n/a	37	BHE-ESD21	P-BESD21	kPa	0.60	0-5000	PAA-23X	4-20mA	146514		SD20	92.9
n/a	38	BHE-ESD22	P-BESD22	kPa	1.00	0-5000	PAA-23X	4-20mA	146515		SD20	92.9
n/a	39	BHE-ESD23	P-BESD23	kPa	0.60	0-5000	PAA-23X	4-20mA	146516		SD20	92.5
n/a	40	BHE-ESD24	P-BESD24	kPa	1.00	0-5000	PAA-23X	4-20mA	146517		SD20	92.0
n/a	41	BHE-ESD25	P-BESD25	kPa	0.30	0-5000	PAA-23X	4-20mA	146518		SD20	90.1
421038.182	42	BHE-E1	P-BE1-I1	kPa		0-5000	PAA-23X	4-20mA			Gallery 98	
	43	BHE-E1	P-BE1-I2	kPa		0-5000	PAA-23X	4-20mA			Gallery 98	
	44	BHE-E1	P-BE1-I3	kPa		0-5000	PAA-23X	4-20mA			Gallery 98	
	45	BHE-E1	P-BE1-I4	kPa		0-5000	PAA-23X	4-20mA		Noisy	Gallery 98	
	46	BHE-E2	P-BE2-I1	kPa		0-5000	PAA-23X	4-20mA			Gallery 98	
	47	BHE-E2	P-BE2-I2	kPa		0-5000	PAA-23X	4-20mA			Gallery 98	
	48	BHE-E2	P-BE2-I3	kPa		0-5000	PAA-23X	4-20mA			Gallery 98	
	49	BHE-E2	P-BE2-I4	kPa		0-5000	PAA-23X	4-20mA		Noisy	Gallery 98	
	50	BHE-E1	P-BE1-P1	kPa		0-5000	PAA-23X	4-20mA			Gallery 98	
	51	BHE-E1	P-BE1-P2	kPa		0-5000	PAA-23X	4-20mA			Gallery 98	
	52	BHE-E1	P-BE1-P3	kPa		0-5000	PAA-23X	4-20mA			Gallery 98	
	53	BHE-E1	P-BE1-P4	kPa		0-5000	PAA-23X	4-20mA			Gallery 98	
54	BHE-E2	P-BE2-P1	kPa		0-5000	PAA-23X	4-20mA			Gallery 98		

INTERFACE Sensor assembling box	DAS - Channel	Borehole	Sensor name	Unit	Depth [m]	Range	Sensor type	Output signal	Sensor SN	Status 28.02.2013	Profile	Atmos- pheric pressure
	55	BHE-E2	P-BE2-P2	kPa		0-5000	PAA-23X	4-20mA		Defective since 18.05.2012	Gallery 98	
	56	BHE-E2	P-BE2-P3	kPa		0-5000	PAA-23X	4-20mA		Defective	Gallery 98	
	57	BHE-E2	P-BE2-P4	kPa		0-5000	PAA-23X	4-20mA			Gallery 98	
ATEMIN Humidity cabinet	65	BVE-95	HC-B95	%RH		0-100	Rotronic	4-20mA	-	Humidity = 100%	SB2	-
	66	BVE-95	T-B95	°C		-40-180	Pt100	4-20mA	-			-
	67	BVE-92	HC-B92	%RH		0-100	Rotronic	4-20mA	-	Humidity = 100%	SB2	-
	68	BVE-92	T-B92	°C		-40-180	Pt100	4-20mA	-			-
	69	BVE-94	HC-B94	%RH		0-100	Rotronic	4-20mA	-	Humidity = 100%	SB2	-
	70	BVE-94	T-B94	°C		-40-180	Pt100	4-20mA	-			-
	71	BVE-93	HC-B93	%RH		0-100	Rotronic	4-20mA	-	Humidity = 100%	SB2	-
	72	BVE-93	T-B93	°C		-40-180	Pt100	4-20mA	-			-
n/a	73	BVE-25	RD-B25	mm	0.0-2.0	25	displacement	0-5 V	-		SD2	-
n/a	74	BVE-26	RD-B26	mm	0.0-2.0	25	displacement	0-5 V	-		SD2	-
n/a	75	BVE-27	RD-B27	mm	0.0-2.0	25	displacement	0-5 V	-	Defective and removed	SD2	-
n/a	76	BVE-28	RD-B28	mm	0.0-2.0	25	displacement	0-5 V	-		SD2	-
n/a	77	BVE-46	RD-B46	mm	0.0-2.0	25	displacement	0-5 V	-		SD1	-
n/a	78	BVE-47	RD-B47	mm	0.0-2.0	25	displacement	0-5 V	-		SD1	-
n/a	79	BVE-48	RD-B48	mm	0.0-2.0	25	displacement	0-5 V	-	Defective and removed	SD1	-
n/a	80	BVE-49	RD-B49	mm	0.0-2.0	25	displacement	0-5 V	-		SD1	-
ATEMIN Humidity cabinet	81	BVE-20	HC-B20	%RH	0.78	0-100	Rotronic	0-5 V	23786 008	Humidity = 100%	SB2	-
	82	BVE-20	T-B20	°C		-40-180°C	Pt100	0-5 V		-		
	83	surface	HC-SB2	%RH	0.00	0-100	Rotronic	0-5 V	23786 007	Humidity = 100%	SB2	-
	84	surface	T-SB2	°C		-40-180°C	Pt100	0-5 V		-		
	85	BVE-18	HC-B18	%RH	0.35	0-100	Rotronic	0-5 V	23786 006	Defective	SB2	-
	86	BVE-18	T-B18	°C		-40-180°C	Pt100	0-5 V		Defective		-
	87	BVE-75	HC-B75	%RH	0.52	0-100	Rotronic	0-5 V	23786 005	Defective	SB1	-
	88	BVE-75	T-B75	°C		-40-180°C	Pt100	0-5 V				-

INTERFACE Sensor assembling box	DAS - Channel	Borehole	Sensor name	Unit	Depth [m]	Range	Sensor type	Output signal	Sensor SN	Status 28.02.2013	Profile	Atmos- pheric pressure
	89	BVE-16	HC-B16	%RH	1.50	0-100	Rotronic	0-5 V	23786 004	Humidity = 100%	SB2	-
	90	BVE-16	T-B16	°C		-40-180	Pt100	0-5 V		Occasionally noisy		-
	91	BVE-12	HC-B12	%RH	1.25	0-100	Rotronic	0-5 V	23786 003	Defective 22.10.12-25.01.2013	SB2	-
	92	BVE-12	T-B12	°C		-40-180	Pt100	0-5 V				-
	93	BVE-14	HC-B14	%RH	0.53	0-100	Rotronic	0-5 V	23786 002	Defective since 09.11.2012	SB2	-
	94	BVE-14	T-B14	°C		-40-180	Pt100	0-5 V				-
	95	BVE-10	HC-B10	%RH	0.27	0-100	Rotronic	0-5 V	23786 001	Humidity = 100%	SB2	-
	96	BVE-10	T-B10	°C		-40-180	Pt100	0-5 V				-
	97	BVE-23	HC-B23	%RH	1.05	0-100	Rotronic	0-5 V	23786 009	Defective since 04.12.2012	SB2	-
	98	BVE-23	T-B23	°C		-40-180	Pt100	0-5 V		Defective		-
	99	surface	HC-SB1	%RH	0.00	0-100	Rotronic	0-5 V	23786 010	Defective since 17.07.2012	SB1	-
	100	surface	T-SB1	°C		-40-180	Pt100	0-5 V				-
	101	BVE-73	HC-B73	%RH	1.25	0-100	Rotronic	0-5 V	23786 011	Humidity = 100%	SB1	-
	102	BVE-73	T-B73	°C		-40-180	Pt100	0-5 V				-
	103	BVE-71	HC-B71	%RH	0.27	0-100	Rotronic	0-5 V	23786 012	Defective since 06.11.2012	SB1	-
	104	BVE-71	T-B71	°C		-40-180	Pt100	0-5 V				-
	105	BVE-77	HC-B77	%RH	1.54	0-100	Rotronic	0-5 V	23786 013	defective	SB1	-
	106	BVE-77	T-B77	°C		-40-180	Pt100	0-5 V				-
	107	BVE-66	HC-B66	%RH	0.78	0-100	Rotronic	0-5 V	23786 014	Humidity = 100%	SB1	-
	108	BVE-66	T-B66	°C		-40-180	Pt100	0-5 V				-
109	BVE-64	HC-B64	%RH	0.37	0-100	Rotronic	0-5 V	23786 015		SB1	-	
110	BVE-64	T-B64	°C		-40-180	Pt100	0-5 V				-	
111	BVE-69	HC-B69	%RH	1.02	0-100	Rotronic	0-5 V	23786 016	Defective	SB1	-	
112	BVE-69	T-B69	°C		-40-180	Pt100	0-5 V				-	
n/a	121	BVE-25	T-B25	°C	0.10	0-100	Pt100	Pt100	-		SD2	-
n/a	122	BVE-26	T-B26	°C	0.10	0-100	Pt100	Pt100	-	Defective	SD2	-
n/a	123	BVE-27	T-B27	°C	0.10	0-100	Pt100	Pt100	-	Noisy	SD2	-

INTERFACE Sensor assembling box	DAS - Channel	Borehole	Sensor name	Unit	Depth [m]	Range	Sensor type	Output signal	Sensor SN	Status 28.02.2013	Profile	Atmos- pheric pressure
n/a	124	BVE-28	T-B28	°C	0.10	0-100	Pt100	Pt100	-		SD2	-
n/a	125	BVE-46	T-B46	°C	0.10	0-100	Pt100	Pt100	-	Defective	SD1	-
n/a	126	BVE-47	T-B47	°C	0.10	0-100	Pt100	Pt100	-	Noisy	SD1	-
n/a	127	BVE-48	T-B48	°C	0.10	0-100	Pt100	Pt100	-	Occasionally noisy	SD1	-
n/a	128	BVE-49	T-B49	°C	0.10	0-100	Pt100	Pt100	-	Defective since 06.09.2012	SD1	-
n/a	129	BHE-ESA21	T-BESA21	°C	0.40	0-100	Pt100	Pt100	-	Occasionally noisy	SA20	-
n/a	130	BHE-ESA22	T-BESA22	°C	0.80	0-100	Pt100	Pt100	-		SA20	-
n/a	131	BHE-ESA23	T-BESA23	°C	0.40	0-100	Pt100	Pt100	-		SA20	-
n/a	132	BHE-ESA24	T-BESA24	°C	0.80	0-100	Pt100	Pt100	-		SA20	-
n/a	133	BHE-ESA25	T-BESA25	°C	0.10	0-100	Pt100	Pt100	-		SA20	-
n/a	134	BHE-ESD21	T-BESD21	°C	0.40	0-100	Pt100	Pt100	-		SD20	-
n/a	135	BHE-ESD22	T-BESD22	°C	0.80	0-100	Pt100	Pt100	-		SD20	-
n/a	136	BHE-ESD23	T-BESD23	°C	0.40	0-100	Pt100	Pt100	-		SD20	-
n/a	137	BHE-ESD24	T-BESD24	°C	0.80	0-100	Pt100	Pt100	-		SD20	-
n/a	138	BHE-ESD25	T-BESD25	°C	0.10	0-100	Pt100	Pt100	-		SD20	-
INTERFACE Humidity Nagra Zone SN 421119.255	202	NSC3	HC-N3-12H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	Nagra carrier 3	-
	203	NSC3	T-N3-12H	°C	0.00	0-165	Pt1000	digital	-		Nagra carrier 3	-
	204	NSC3	HC-N3-3H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	Nagra carrier 3	-
	205	NSC3	T-N3-3H	°C	0.00	0-165	Pt1000	digital	-		Nagra carrier 3	-
	206	NSC3	HC-N3-9H	%RH	0.00	0-100	IST humidity	digital	-		Nagra carrier 3	-
	207	NSC3	T-N3-9H	°C	0.00	0-165	Pt1000	digital	-		Nagra carrier 3	-
	208	NSC3	HC-N3-5Bt	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 3	-
	209	NSC3	T-N3-5Bt	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 3	-
	210	NSC2	HC-N2-5Bt	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 2	-
	211	NSC2	T-N2-5Bt	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 2	-
	212	NSC2	HC-N2-5Bt	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 2	-
213	NSC2	T-N2-5Bt	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 2	-	

INTERFACE Sensor assembling box	DAS - Channel	Borehole	Sensor name	Unit	Depth [m]	Range	Sensor type	Output signal	Sensor SN	Status 28.02.2013	Profile	Atmos- pheric pressure
	214	NSC3	HC-N3-12C	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 3	-
	215	NSC3	T-N3-12C	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 3	-
	216	NSC3	HC-N3-12M	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 3	-
	217	NSC3	T-N3-12M	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 3	-
	218	NSC3	HC-N3-3M	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 3	-
	219	NSC3	T-N3-3M	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 3	-
	220	NSC3	HC-N3-3C	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 3	-
	221	NSC3	T-N3-3C	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 3	-
	222	NSC1	HC-N1-3M	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 1	-
	223	NSC1	T-N1-3M	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 1	-
	224	NSC1	HC-N1-3C	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 1	-
	225	NSC1	T-N1-3C	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 1	-
	226	NSC3	HC-N3-9M	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 3	-
	227	NSC3	T-N3-9M	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 3	-
	228	NSC1	HC-N1-5Bt	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 1	-
	229	NSC1	T-N1-5Bt	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 1	-
	230	NSC2	HC-N2-12H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	Nagra carrier 2	-
	231	NSC2	T-N2-12H	°C	0.00	0-165	Pt1000	digital	-		Nagra carrier 2	-
	232	NSC2	HC-N2-3M	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 2	-
	233	NSC2	T-N2-3M	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 2	-
	234	NSC2	HC-N2-3H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	Nagra carrier 2	-
	235	NSC2	T-N2-3H	°C	0.00	0-165	Pt1000	digital	-		Nagra carrier 2	-
	238	NSC2	HC-N2-3C	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 2	-
	239	NSC2	T-N2-3C	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 2	-
	240	NSC1	HC-N1-12H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	Nagra carrier 1	-
	241	NSC1	T-N1-12H	°C	0.00	0-165	Pt1000	digital	-		Nagra carrier 1	-
	242	NSC1	HC-N1-3H	%RH	0.00	0-100	IST humidity	digital	-		Nagra carrier 1	-

INTERFACE Sensor assembling box	DAS - Channel	Borehole	Sensor name	Unit	Depth [m]	Range	Sensor type	Output signal	Sensor SN	Status 28.02.2013	Profile	Atmos- pheric pressure
	243	NSC1	T-N1-3H	°C	0.00	0-165	Pt1000	digital	-		Nagra carrier 1	-
	244	NSC1	HC-N1-9H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	Nagra carrier 1	-
	245	NSC1	T-N1-9H	°C	0.00	0-165	Pt1000	digital	-		Nagra carrier 1	-
	246	NSC2	HC-N2-9H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	Nagra carrier 2	-
	247	NSC2	T-N2-9H	°C	0.00	0-165	Pt1000	digital	-		Nagra carrier 2	-
	248	NSC2	HC-N2-12M	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 2	-
	249	NSC2	T-N2-12M	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 2	-
	250	NSC3	HC-N3-9C	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 3	-
	251	NSC3	T-N3-9C	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 3	-
	252	NSC2	HC-N2-7BI	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 2	-
	253	NSC2	T-N2-7BI	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 2	-
	254	NSC2	HC-N2-9C	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 2	-
	255	NSC2	T-N2-9C	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 2	-
	256	NSC3	HC-N3-7BI	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 3	-
	257	NSC3	T-N3-7BI	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 3	-
	258	NSC2	HC-N2-9M	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 2	-
	259	NSC2	T-N2-9M	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 2	-
	260	NSC1	HC-N1-12C	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 1	-
	261	NSC1	T-N1-12C	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 1	-
	262	NSC1	HC-N1-9M	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 1	-
	263	NSC1	T-N1-9M	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 1	-
	264	NSC1	HC-N1-12M	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 1	-
	265	NSC1	T-N1-12M	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 1	-
	266	NSC3	HC-N3-7BI	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 3	-
	267	NSC3	T-N3-7BI	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 3	-
	268	NSC2	HC-N2-7BI	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 2	-
	269	NSC2	T-N2-7BI	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 2	-

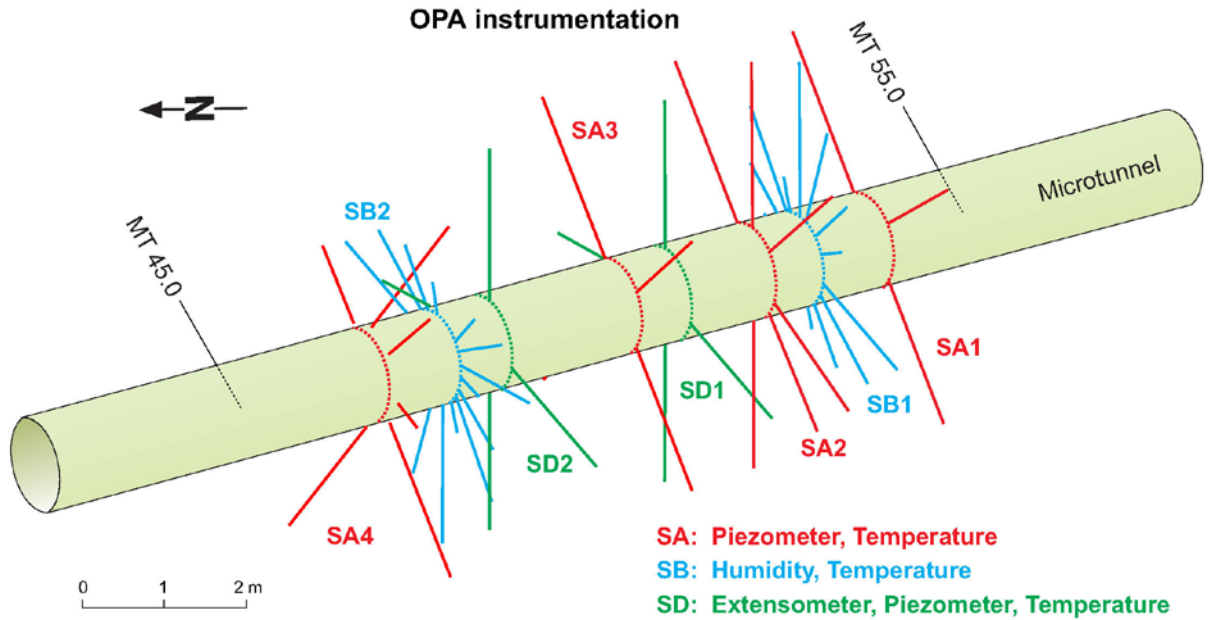
INTERFACE Sensor assembling box	DAS - Channel	Borehole	Sensor name	Unit	Depth [m]	Range	Sensor type	Output signal	Sensor SN	Status 28.02.2013	Profile	Atmos- pheric pressure	
	270	NSC1	HC-N1-9C	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 1	-	
	271	NSC1	T-N1-9C	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 1	-	
	272	NSC1	HC-N1-7BI	%RH	-0.20	0-100	IST humidity	digital	-		Nagra carrier 1	-	
	273	NSC1	T-N1-7BI	°C	-0.20	0-165	Pt1000	digital	-		Nagra carrier 1	-	
	274	NSC1	HC-N1-7BI	%RH	-0.35	0-100	IST humidity	digital	-		Nagra carrier 1	-	
	275	NSC1	T-N1-7BI	°C	-0.35	0-165	Pt1000	digital	-		Nagra carrier 1	-	
	276	NSC2	HC-N2-12C	%RH	-0.35	0-100	IST humidity	digital	-			Nagra carrier 2	-
	277	NSC2	T-N2-12C	°C	-0.35	0-165	Pt1000	digital	-			Nagra carrier 2	-
	278	NSC3	HC-N3-5BI	%RH	-0.20	0-100	IST humidity	digital	-		Defective	Nagra carrier 3	-
	279	NSC3	T-N3-5BI	°C	-0.20	0-165	Pt1000	digital	-		Defective	Nagra carrier 3	-
	280	NSC1	HC-N1-R	%RH	-0.10	0-100	IST humidity	digital	-			Nagra carrier 1	-
281	NSC1	T-N1-R	°C	-0.10	0-165	Pt1000	digital	-			Nagra carrier 1	-	
INTERFACE Humidity GRS Zone	302	GSC3	HC-G3-7BI	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 3	-	
	303	GSC3	T-G3-7BI	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 3	-	
	304	GSC2	HC-G2-9M	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 2	-	
	305	GSC2	T-G2-9M	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 2	-	
	306	GSC1	HC-G1-7BI	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 1	-	
	307	GSC1	T-G1-7BI	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 1	-	
	308	GSC1	HC-G1-9M	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 1	-	
	309	GSC1	T-G1-9M	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 1	-	
	310	GSC1	HC-G1-5BI	%RH	-0.10	0-100	IST humidity	digital	-			GRS carrier 1	-
	311	GSC1	T-G1-5BI	°C	-0.10	0-165	Pt1000	digital	-			GRS carrier 1	-
	312	GSC1	HC-G1-12M	%RH	-0.20	0-100	IST humidity	digital	-			GRS carrier 1	-
	313	GSC1	T-G1-12M	°C	-0.20	0-165	Pt1000	digital	-			GRS carrier 1	-
	314	GSC2	HC-G2-12C	%RH	-0.35	0-100	IST humidity	digital	-			GRS carrier 2	-
	315	GSC2	T-G2-12C	°C	-0.35	0-165	Pt1000	digital	-			GRS carrier 2	-
	316	GSC1	HC-G1-12H	%RH	0.00	0-100	IST humidity	digital	-		Humidity = 100%	GRS carrier 1	-

INTERFACE Sensor assembling box	DAS - Channel	Borehole	Sensor name	Unit	Depth [m]	Range	Sensor type	Output signal	Sensor SN	Status 28.02.2013	Profile	Atmos- pheric pressure
	317	GSC1	T-G1-12H	°C	0.00	0-165	Pt1000	digital	-	Defective since 10.12.2012	GRS carrier 1	-
	318	GSC1	HC-G1-7Bt	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 1	-
	319	GSC1	T-G1-7Bt	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 1	-
	320	GSC1	HC-G1-9H	%RH	0.00	0-100	IST humidity	digital	-	Defective since 11.06.2012	GRS carrier 1	-
	321	GSC1	T-G1-9H	°C	0.00	0-165	Pt1000	digital	-	Defective	GRS carrier 1	-
	322	GSC2	HC-G2-12H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	GRS carrier 2	-
	323	GSC2	T-G2-12H	°C	0.00	0-165	Pt1000	digital	-		GRS carrier 2	-
	324	GSC2	HC-G2-7Bt	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 2	-
	325	GSC2	T-G2-7Bt	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 2	-
	326	GSC2	HC-G2-9C	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 2	-
	327	GSC2	T-G2-9C	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 2	-
	328	GSC2	HC-G2-7Bt	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 2	-
	329	GSC2	T-G2-7Bt	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 2	-
	332	GSC3	HC-G3-7Bt	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 3	-
	333	GSC3	T-G3-7Bt	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 3	-
	334	GSC3	HC-G3-9C	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 3	-
	335	GSC3	T-G3-9C	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 3	-
	336	GSC1	HC-G1-9C	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 1	-
	337	GSC1	T-G1-9C	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 1	-
	338	GSC3	HC-G3-12H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	GRS carrier 3	-
	339	GSC3	T-G3-12H	°C	0.00	0-165	Pt1000	digital	-		GRS carrier 3	-
	340	GSC1	HC-G1-3H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	GRS carrier 1	-
	341	GSC1	T-G1-3H	°C	0.00	0-165	Pt1000	digital	-		GRS carrier 1	-
	342	GSC3	HC-G3-9M	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 3	-
	343	GSC3	T-G3-9M	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 3	-
	344	GSC3	HC-G3-12C	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 3	-
	345	GSC3	T-G3-12C	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 3	-

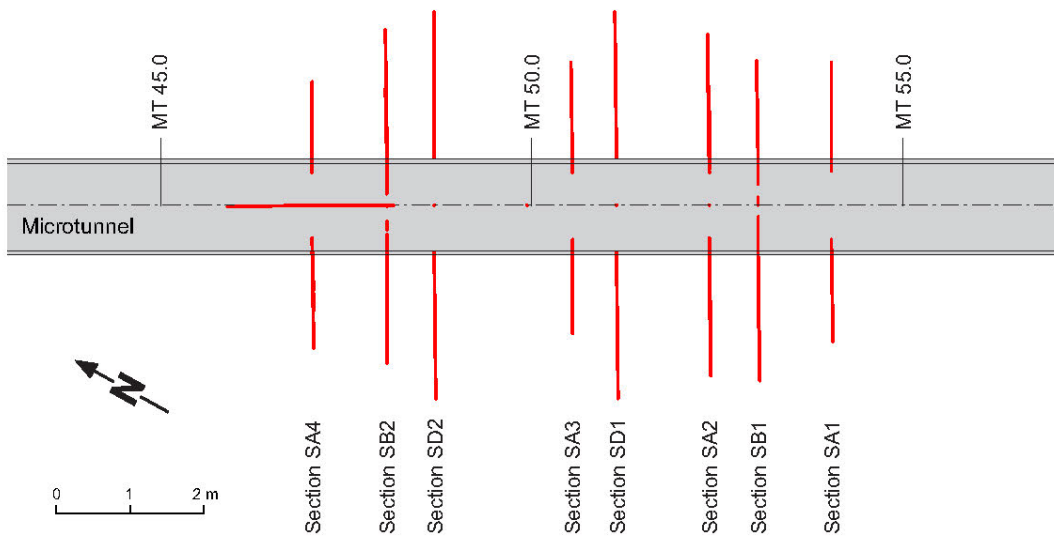
INTERFACE Sensor assembling box	DAS - Channel	Borehole	Sensor name	Unit	Depth [m]	Range	Sensor type	Output signal	Sensor SN	Status 28.02.2013	Profile	Atmos- pheric pressure
	346	GSC1	HC-G1-3M	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 1	-
	347	GSC1	T-G1-3M	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 1	-
	348	GSC1	HC-G1-3C	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 1	-
	349	GSC1	T-G1-3C	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 1	-
	350	GSC3	HC-G3-12M	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 3	-
	351	GSC3	T-G3-12M	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 3	-
	352	GSC2	HC-G2-12M	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 2	-
	353	GSC2	T-G2-12M	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 2	-
	354	GSC1	HC-G1-12C	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 1	-
	355	GSC1	T-G1-12C	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 1	-
	356	GSC1	HC-G1-5Bt	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 1	-
	357	GSC1	T-G1-5Bt	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 1	-
	358	GSC2	HC-G2-3H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	GRS carrier 2	-
	359	GSC2	T-G2-3H	°C	0.00	0-165	Pt1000	digital	-	Defective since 14.07.2012	GRS carrier 2	-
	360	GSC2	HC-G2-9H	%RH	0.00	0-100	IST humidity	digital	-	Humidity = 100%	GRS carrier 2	-
	361	GSC2	T-G2-9H	°C	0.00	0-165	Pt1000	digital	-		GRS carrier 2	-
	362	GSC2	HC-G2-3C	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 2	-
	363	GSC2	T-G2-3C	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 2	-
	364	GSC2	HC-G2-3M	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 2	-
	365	GSC2	T-G2-3M	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 2	-
	366	GSC3	HC-G3-9H	%RH	0.00	0-100	IST humidity	digital	-	Defective since 11.06.2012	GRS carrier 3	-
	367	GSC3	T-G3-9H	°C	0.00	0-165	Pt1000	digital	-	Defective since 28.02.2012	GRS carrier 3	-
	368	GSC3	HC-G3-5Bl	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 3	-
	369	GSC3	T-G3-5Bl	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 3	-
	370	GSC3	HC-G3-R	%RH	-0.10	0-100	IST humidity	digital	-		GRS carrier 3	-
	371	GSC3	T-G3-R	°C	-0.10	0-165	Pt1000	digital	-		GRS carrier 3	-
	372	GSC3	HC-G3-3M	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 3	-

INTERFACE Sensor assembling box	DAS - Channel	Borehole	Sensor name	Unit	Depth [m]	Range	Sensor type	Output signal	Sensor SN	Status 28.02.2013	Profile	Atmos- pheric pressure
	373	GSC3	T-G3-3M	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 3	-
	374	GSC3	HC-G3-3C	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 3	-
	375	GSC3	T-G3-3C	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 3	-
	376	GSC2	HC-G2-5Bl	%RH	-0.20	0-100	IST humidity	digital	-		GRS carrier 2	-
	377	GSC2	T-G2-5Bl	°C	-0.20	0-165	Pt1000	digital	-		GRS carrier 2	-
	378	GSC2	HC-G2-5Bl	%RH	-0.35	0-100	IST humidity	digital	-		GRS carrier 2	-
	379	GSC2	T-G2-5Bl	°C	-0.35	0-165	Pt1000	digital	-		GRS carrier 2	-
	380	GSC3	HC-G3-3H	%RH	0.040	0-100	IST humidity	digital	-	Humidity = 100%	GRS carrier 3	-
	381	GSC3	T-G3-3H	°C	0.00	0-165	Pt1000	digital	-		GRS carrier 3	-
ATEMIN Humidity CR7 system	Psychro-01	BVE-11	HC-B11	%RH	0.77	95-99.96	Wescor PST-55	digital	-	Humidity > 99.96%	SB2	-CR 7 logger removed on 22.05.2012
	Psychro-02	BVE-13	HC-B13	%RH	1.76	95-99.96	Wescor PST-55	digital	-	Wrong humidity/not used	SB2	
	Psychro-03	BVE-17	HC-B17	%RH	2.00	95-99.96	Wescor PST-55	digital	39870	Wrong humidity/not used	SB2	
	Psychro-04	BVE-19	HC-B19	%RH	1.25	95-99.96	Wescor PST-55	digital	-		SB2	
	Psychro-06	BVE-21	HC-B21	%RH	0.26	95-99.96	Wescor PST-55	digital	-		SB2	
	Psychro-08	BVE-24	HC-B24	%RH	0.52	95-99.96	Wescor PST-55	digital	-	Wrong humidity/not used	SB2	
	Psychro-09	BVE-65	HC-B65	%RH	1.31	95-99.96	Wescor PST-55	digital	-	Wrong humidity/not used	SB1	
	Psychro-11	BVE-67	HC-B67	%RH	0.27	95-99.96	Wescor PST-55	digital	-	Wrong humidity/not used	SB1	
	Psychro-13	BVE-74	HC-B74	%RH	1.75	95-99.96	Wescor PST-55	digital	-	Wrong humidity/not used	SB1	
	Psychro-16	Not identified	1	%RH		95-99.96	Wescor PST-55	digital	-	Wrong humidity/not used	n/a	
	Psychro-17	BVE-63	HC-B63	%RH	2.02	95-99.96	Wescor PST-55	digital	39884	Wrong humidity/not used	SB1	
	Psychro-18	-	Long green	%RH		95-99.96	Wescor PST-55	digital	-	Wrong humidity/not used	n/a	
	Psychro-20	Not identified	2	%RH		95-99.96	Wescor PST-55	digital	-	Wrong humidity/not used	n/a	
	Psychro-21	BVE-22	HC-B22	%RH	1.50	95-99.96	Wescor PST-55	digital	39867	Wrong humidity/not used	SB2	
	Psychro-22	BVE-68	HC-B68	%RH	1.53	95-99.96	Wescor PST-55	digital	-	Wrong humidity/not used	SB1	
	Psychro-23	-	Short green	%RH		95-99.96	Wescor PST-55	digital	-	Humidity > 99.96%	n/a	
Psychro-25	BVE-76	HC-B76	%RH	1.07	95-99.96	Wescor PST-55	digital	-	Humidity < 95%	SB1		

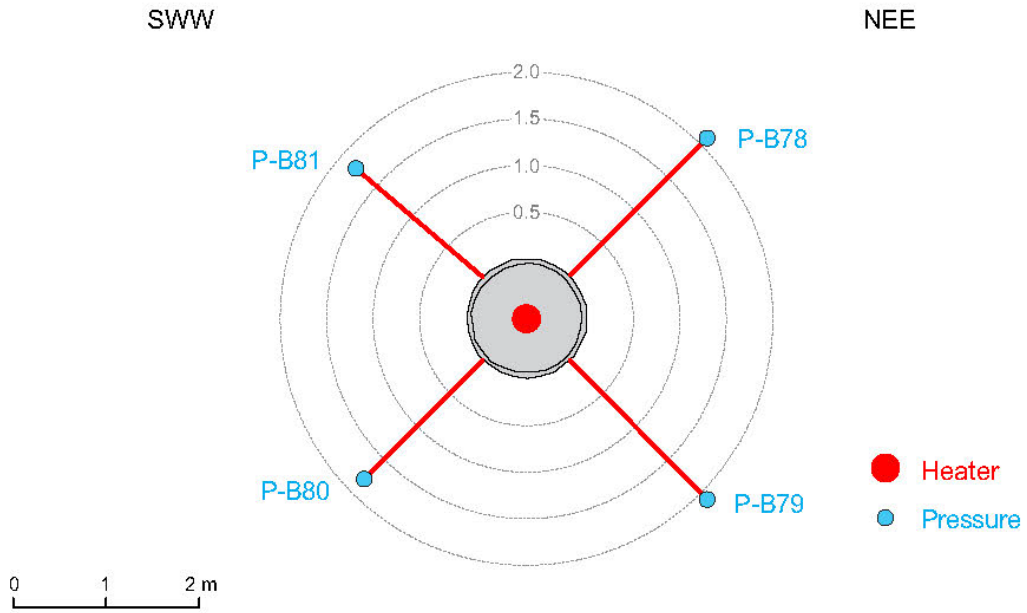
OPA Instrumentation - microtunnel sections



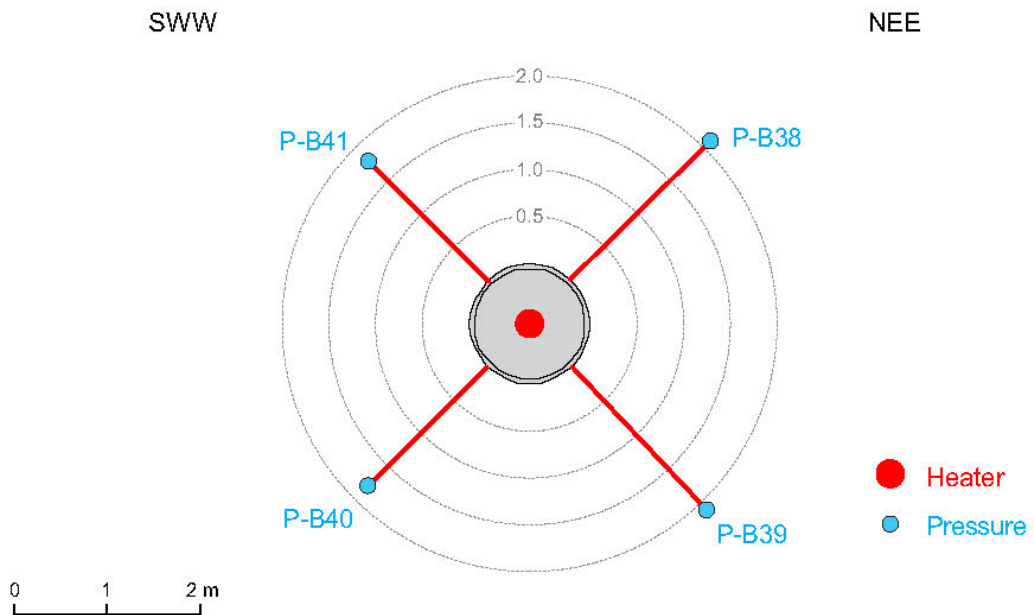
Horizontal section



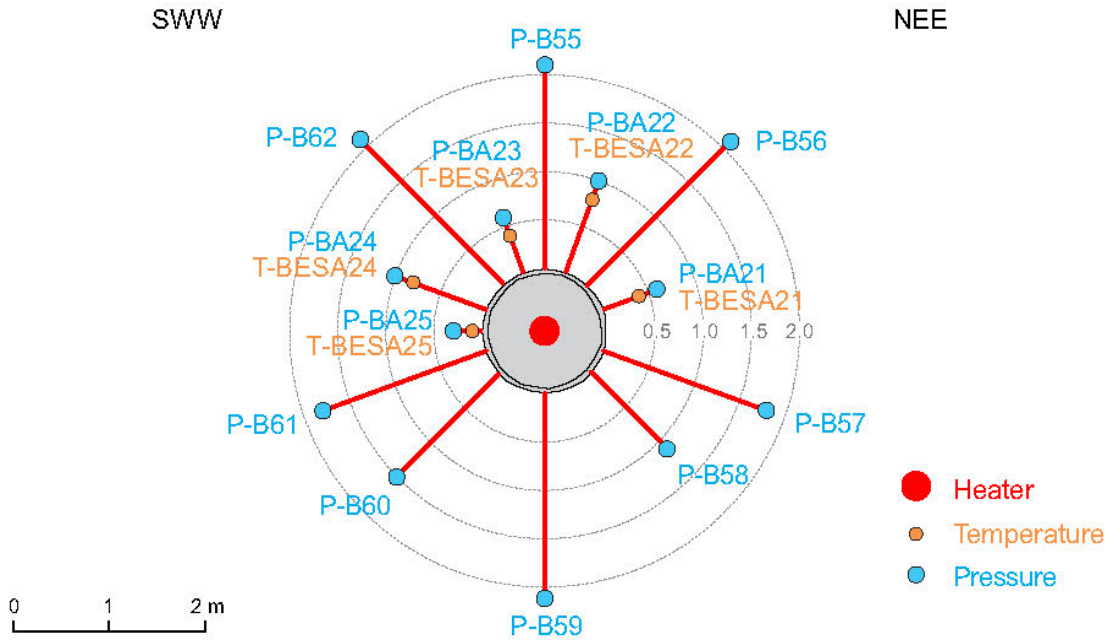
Section SA1



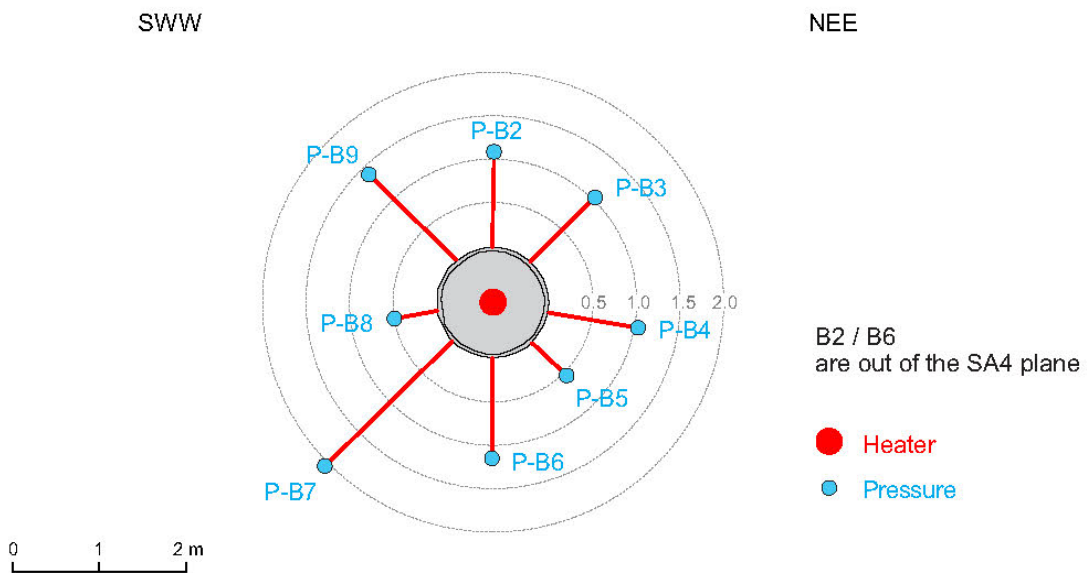
Section SA3



Section SA2



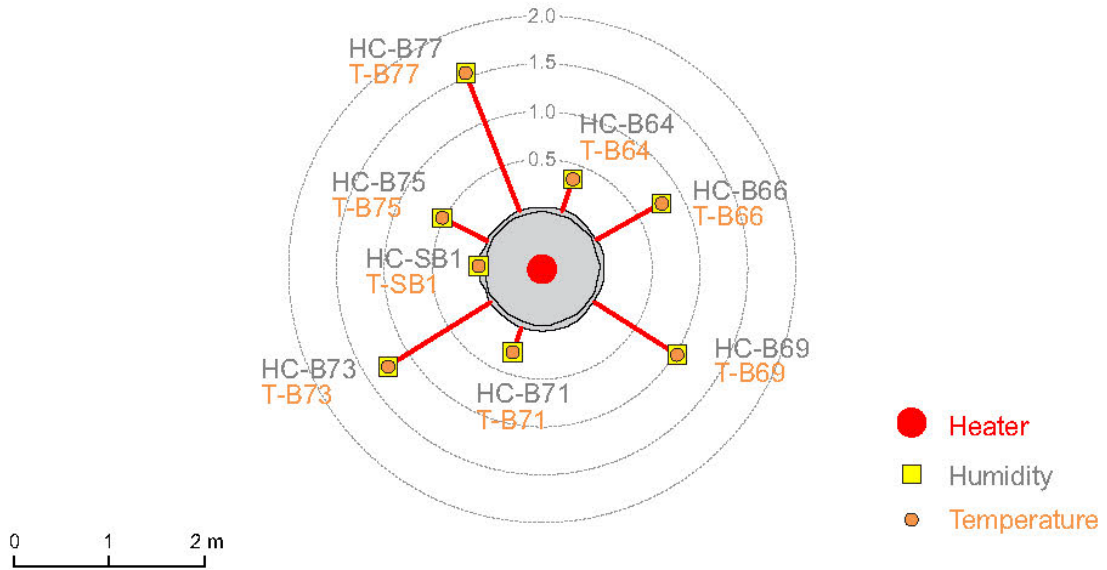
Section SA4



Section SB1

SWW

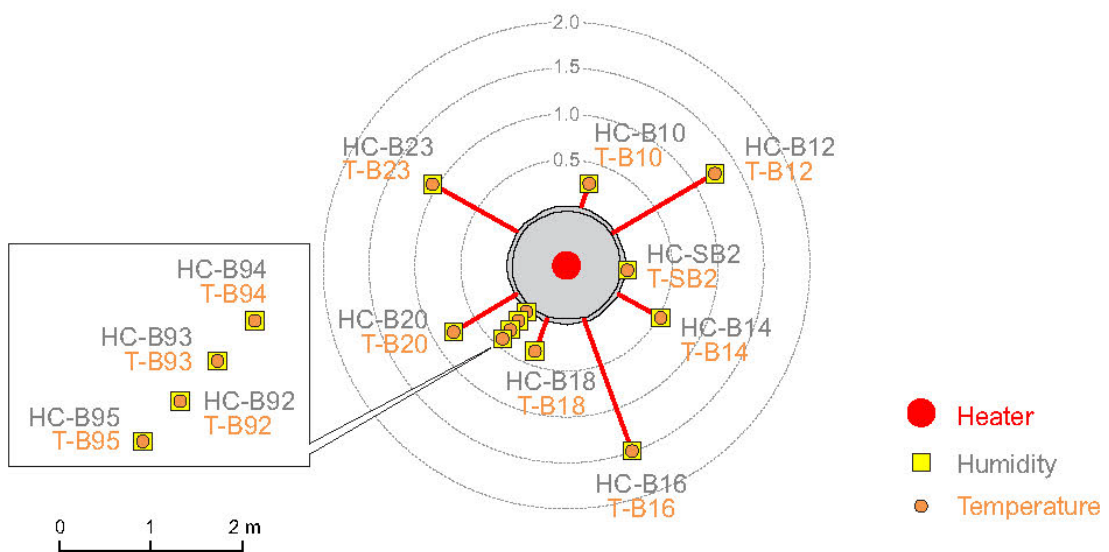
NEE



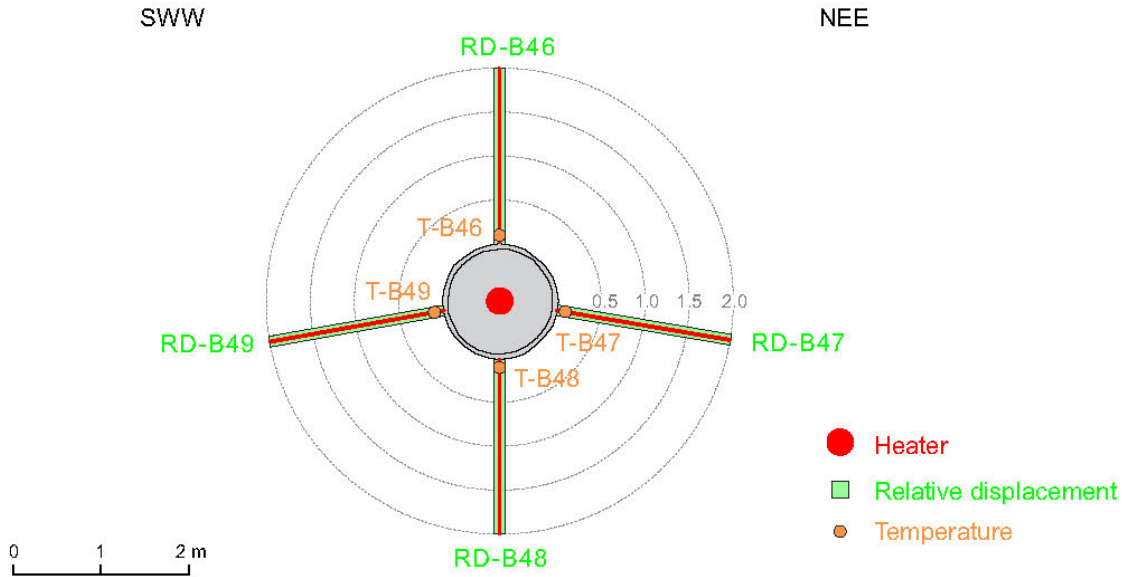
Section SB2

SWW

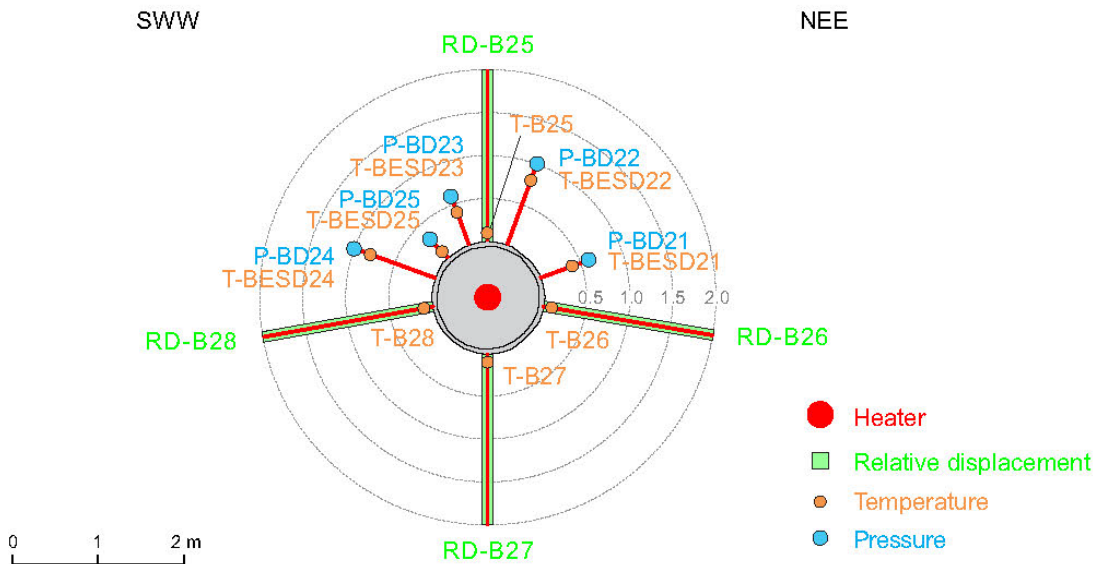
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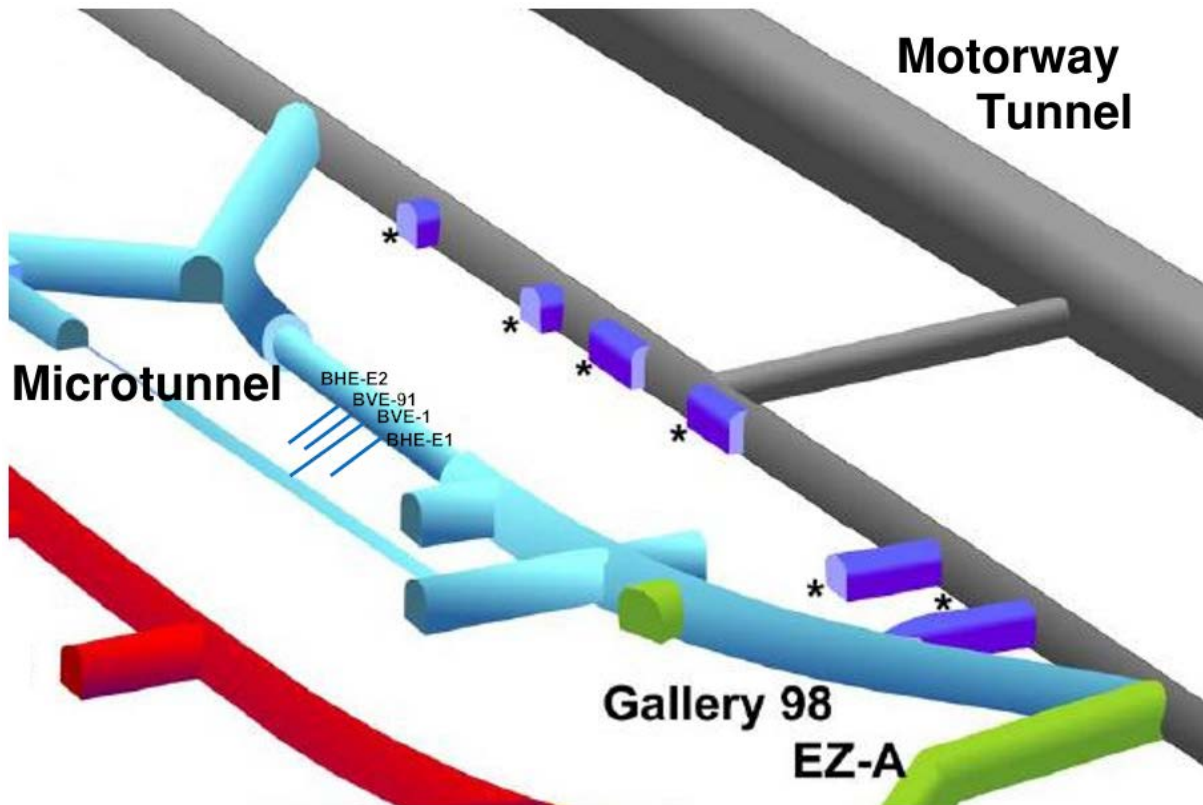
Section SD1



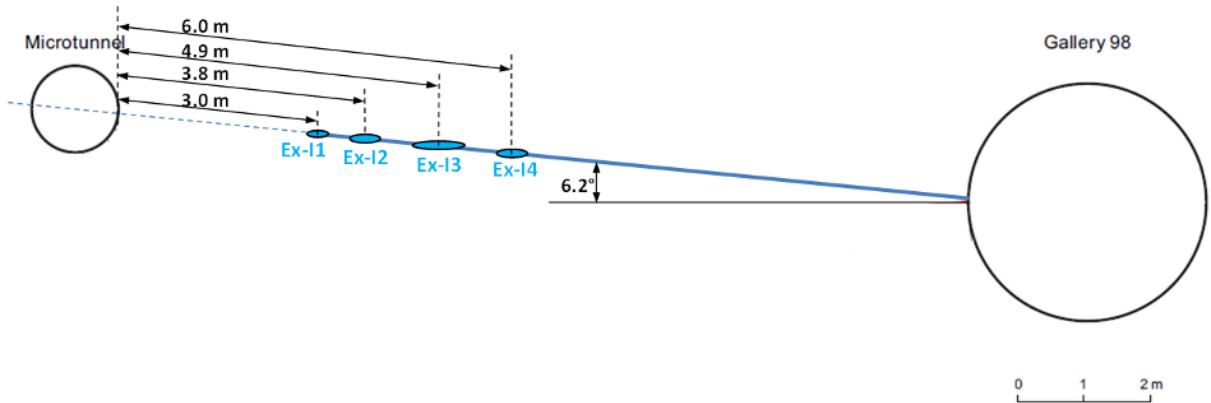
Section SD2



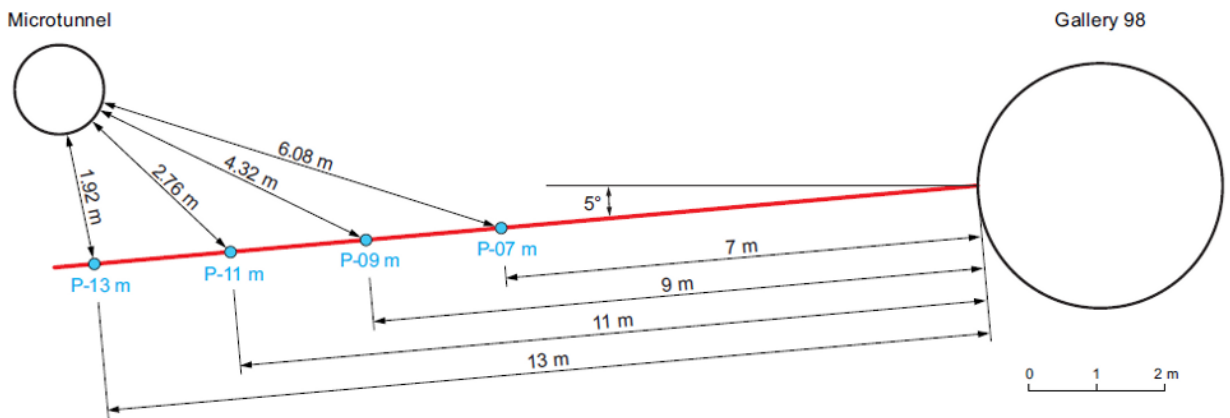
OPA instrumentation - gallery boreholes



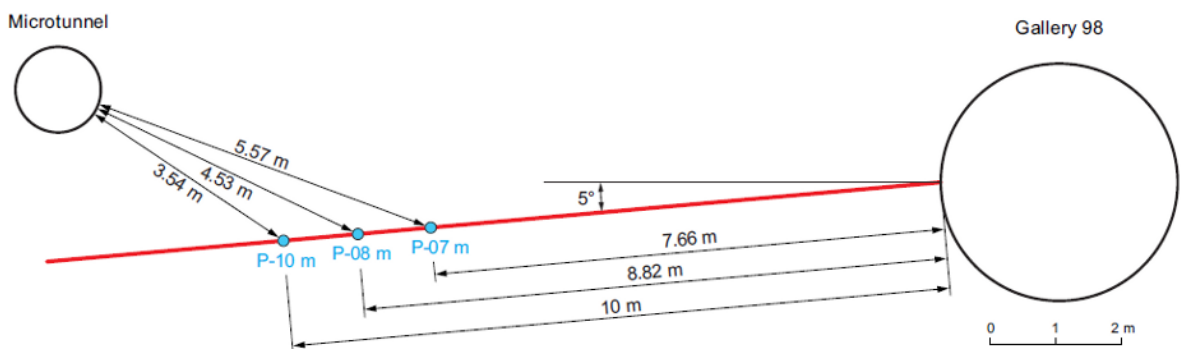
Borehole BHE-E1 and BHE-E2



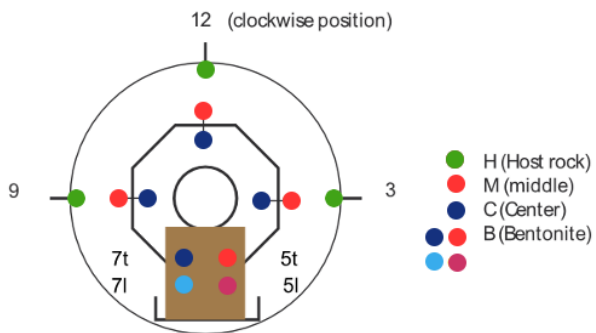
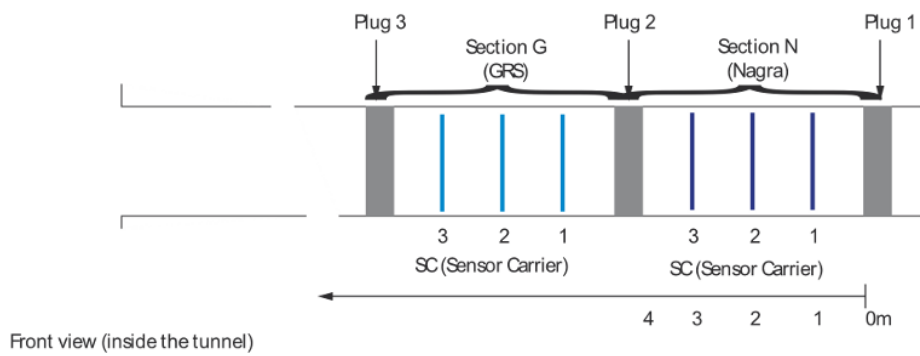
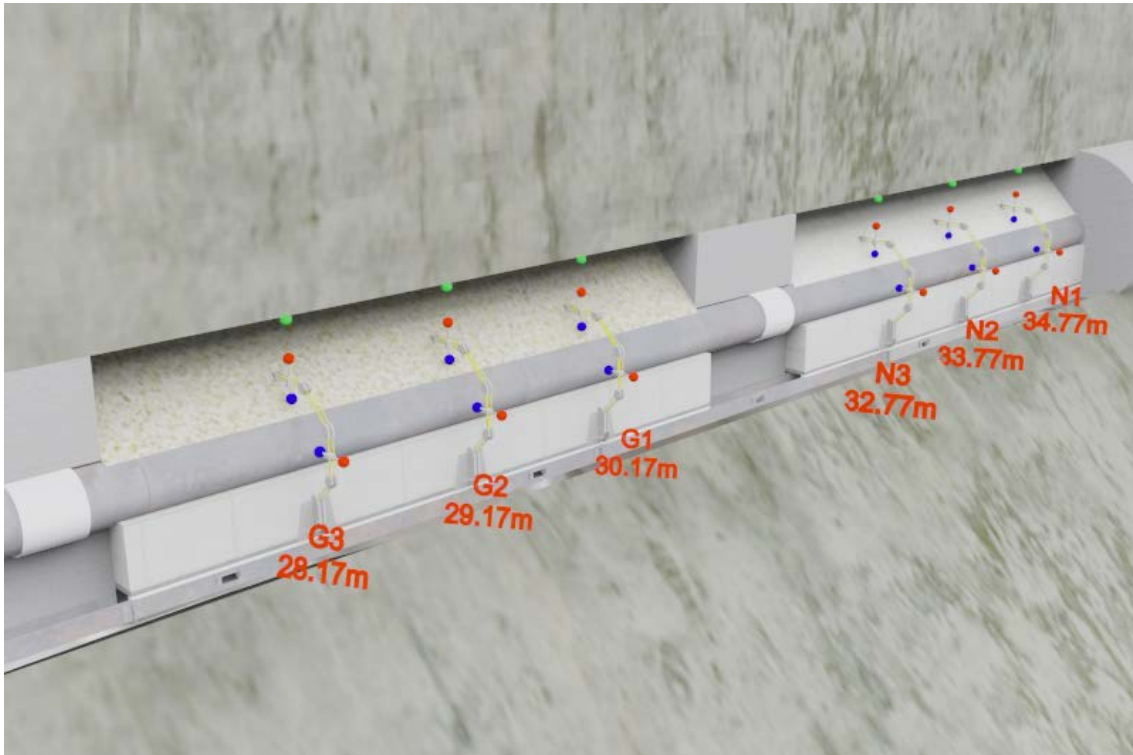
Borehole BVE-1



Borehole BVE-91

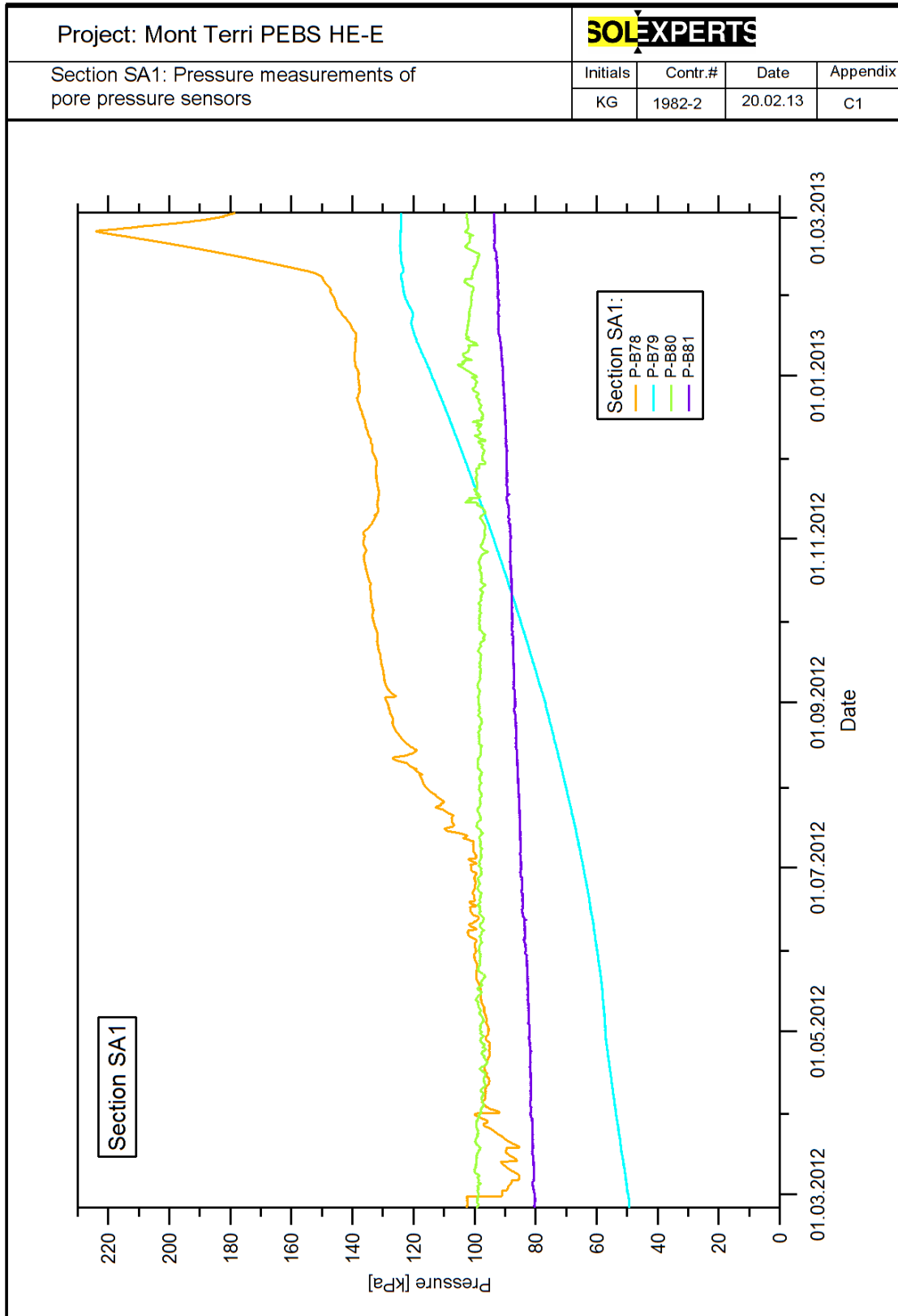


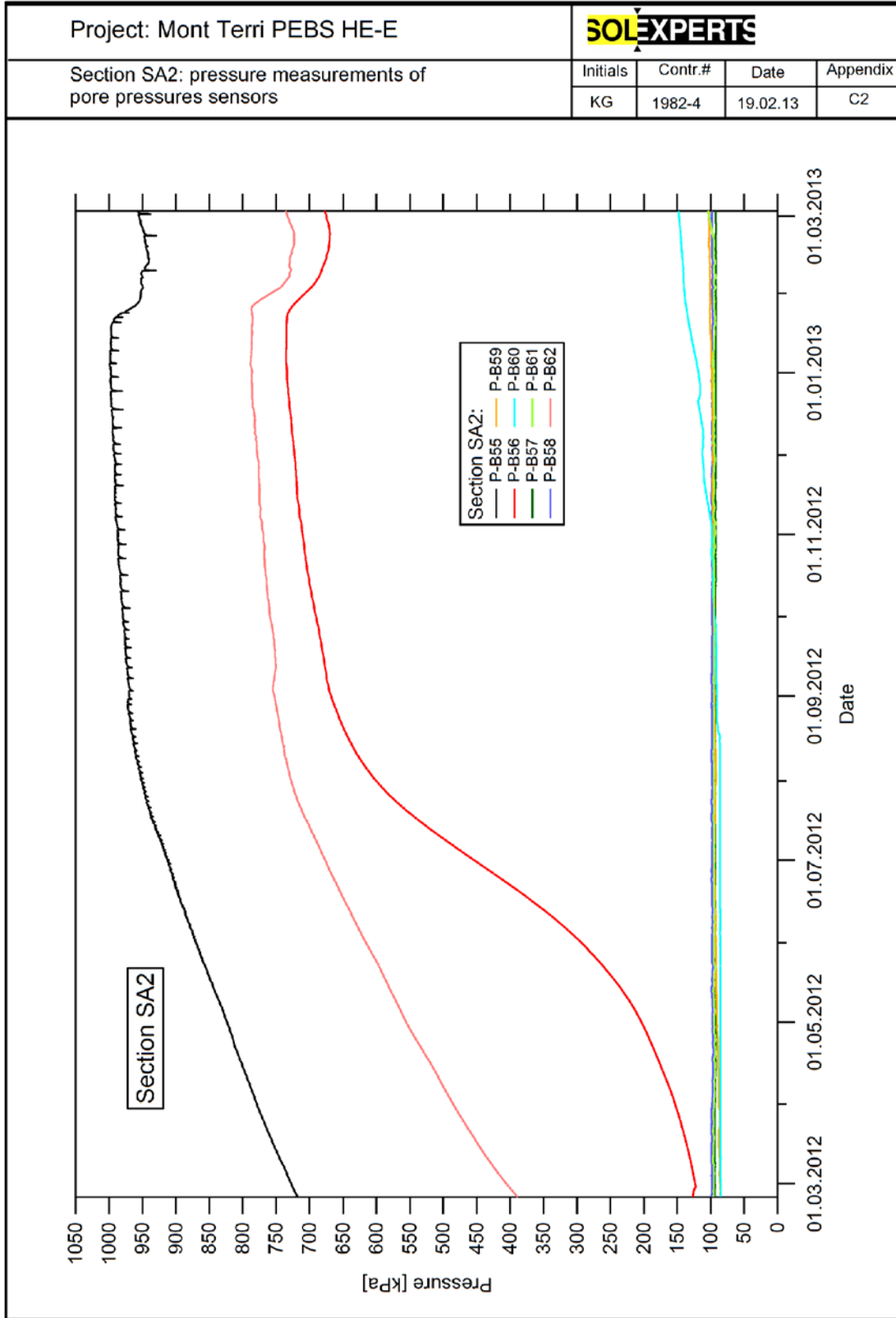
Engineered barrier instrumentation

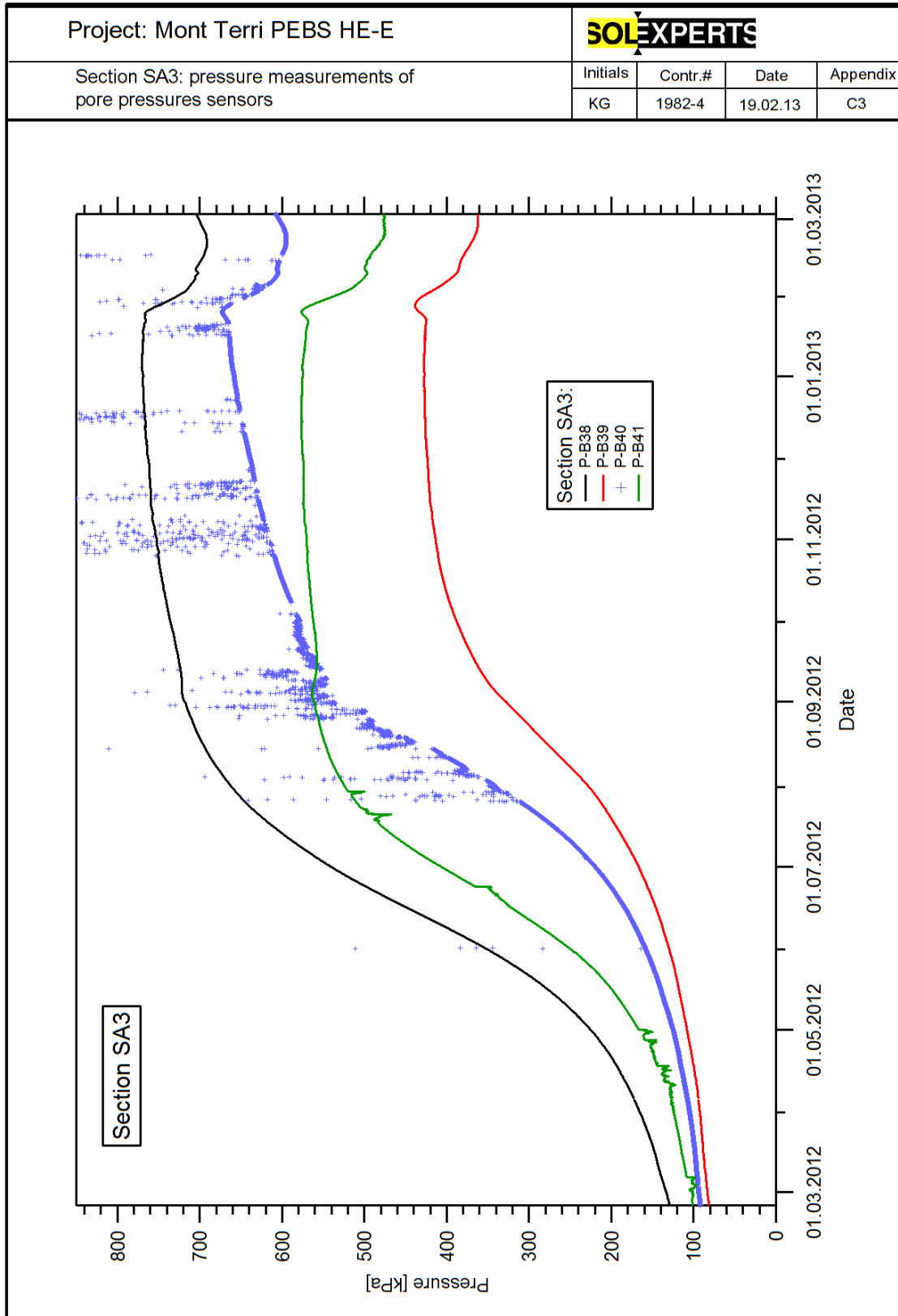


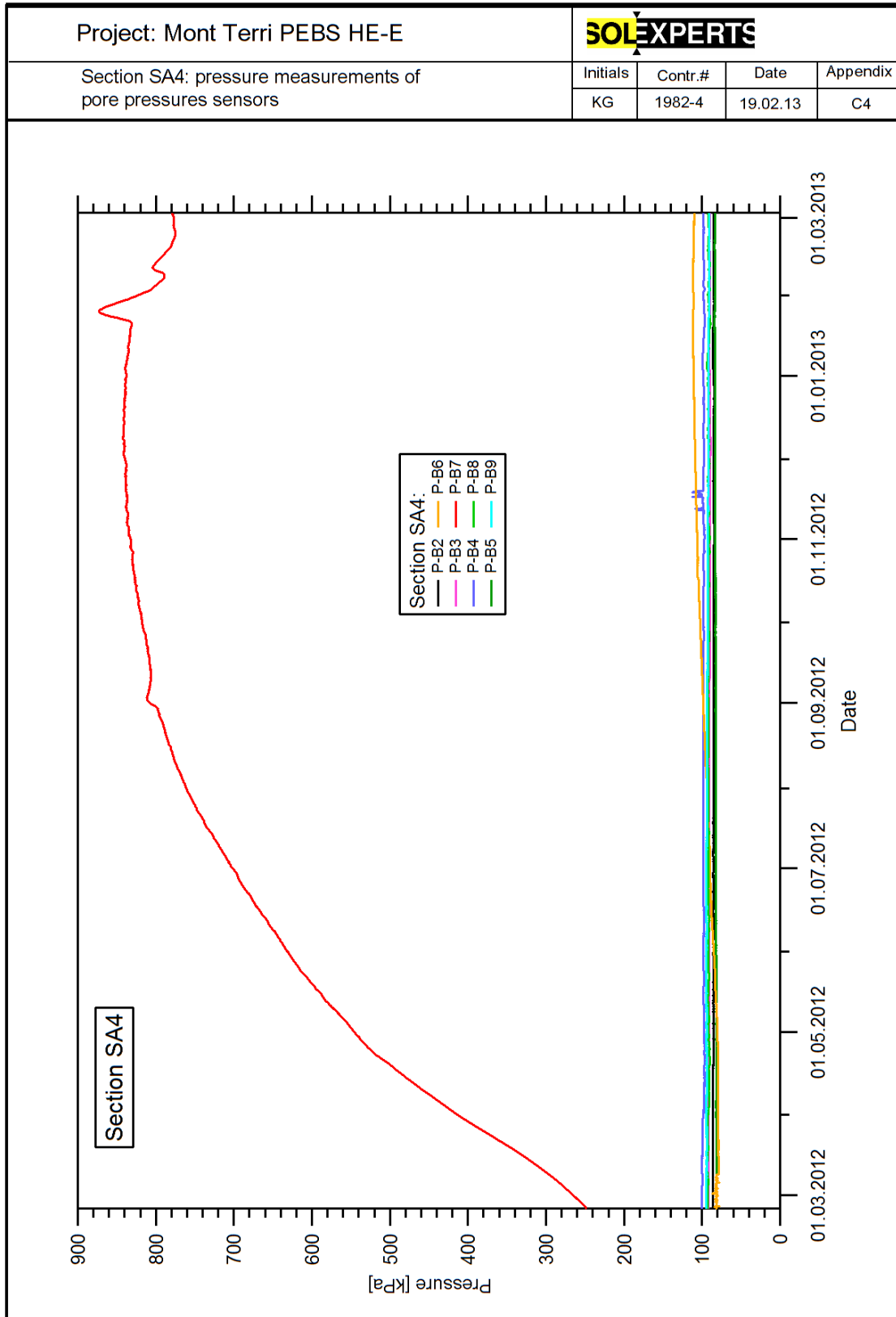
Appendix C:

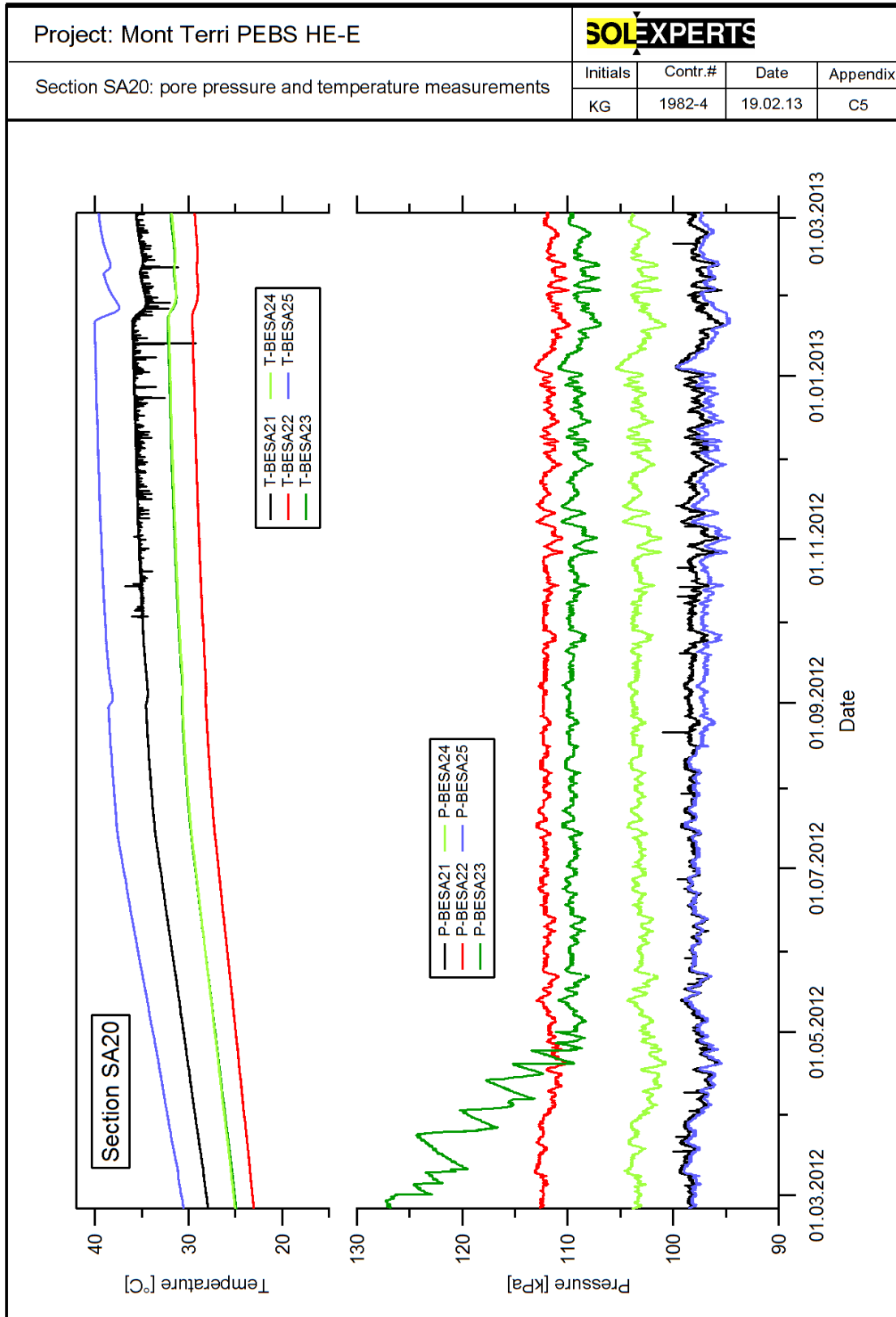
- *Data plots of the sensor in microtunnel sections*

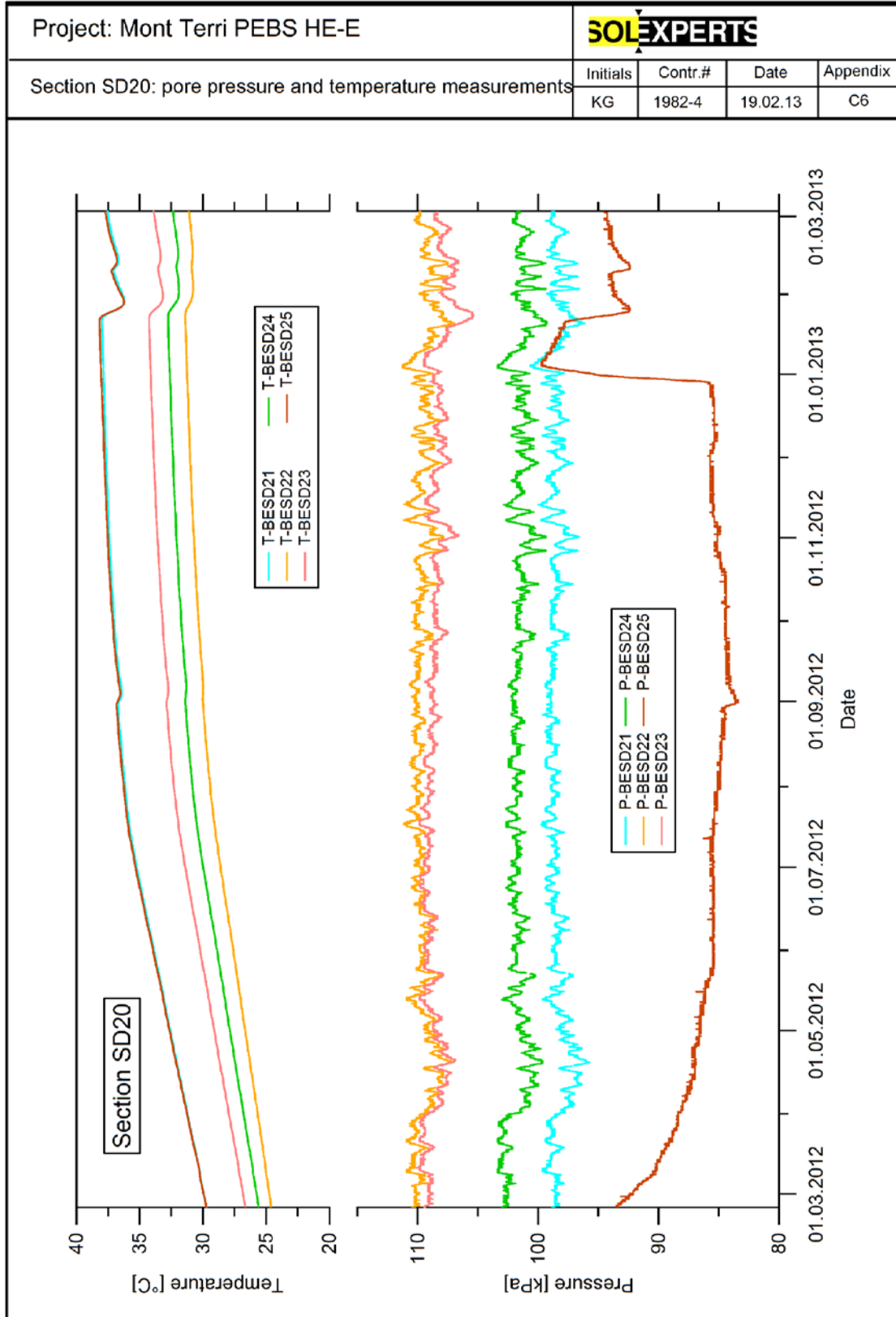


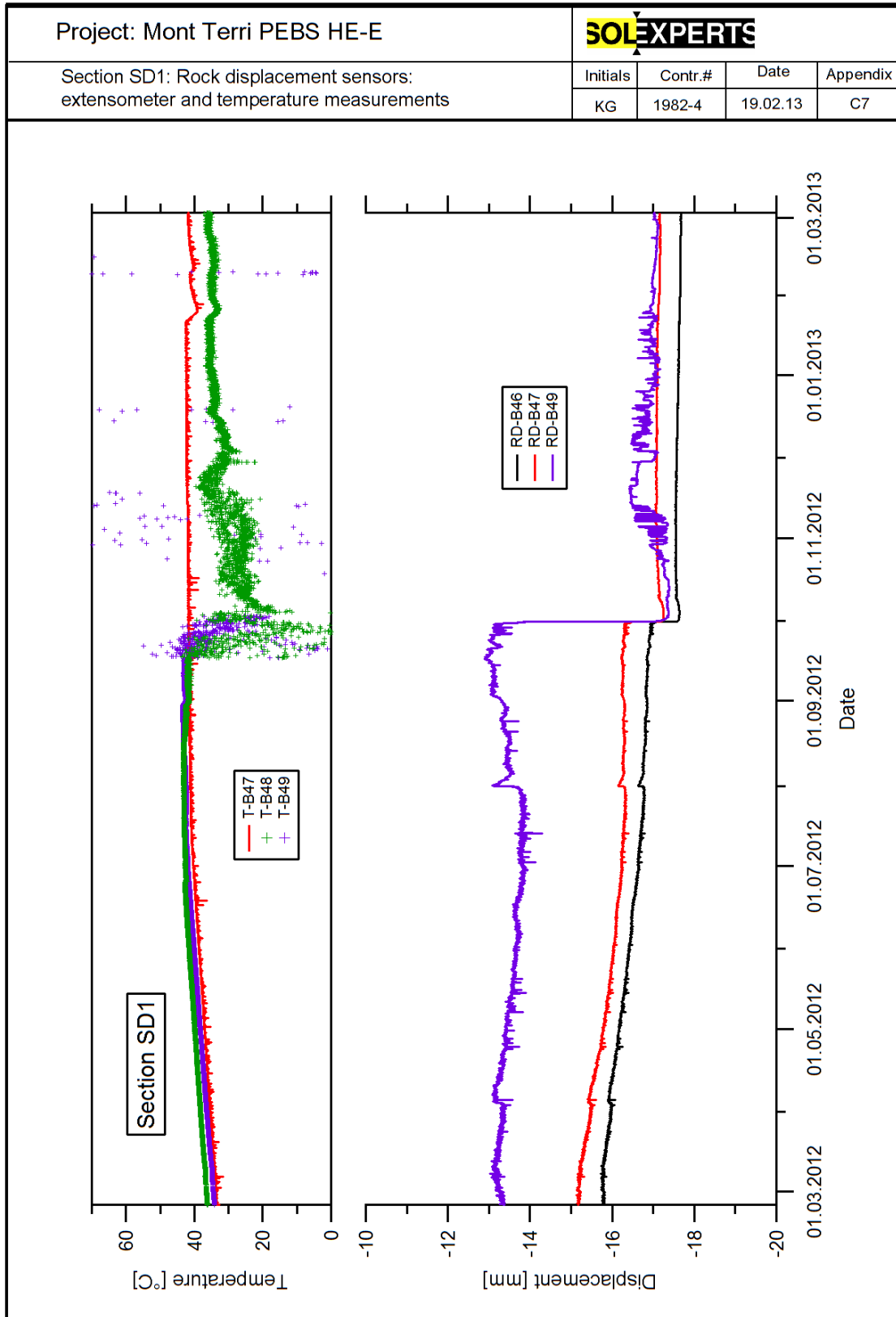


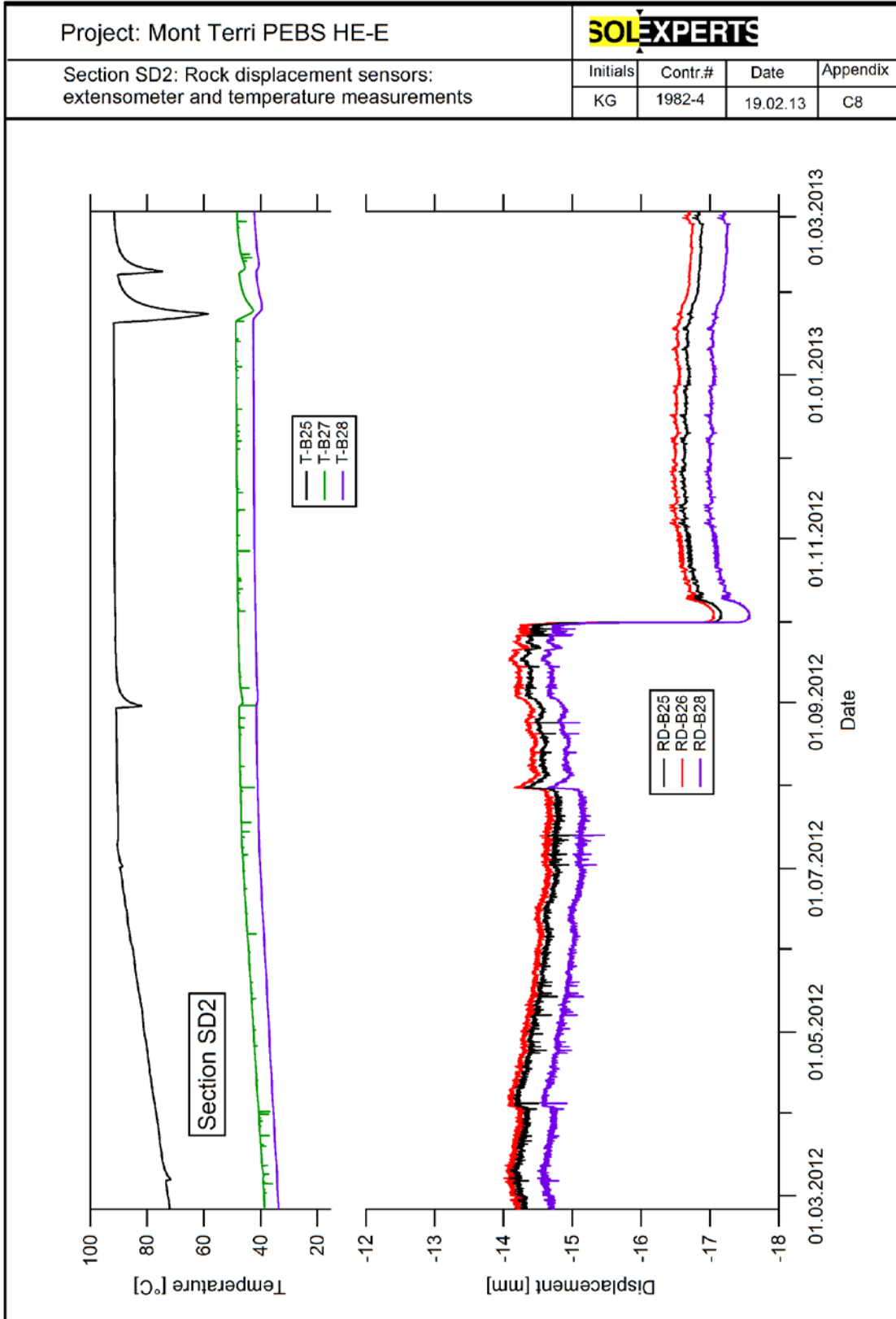


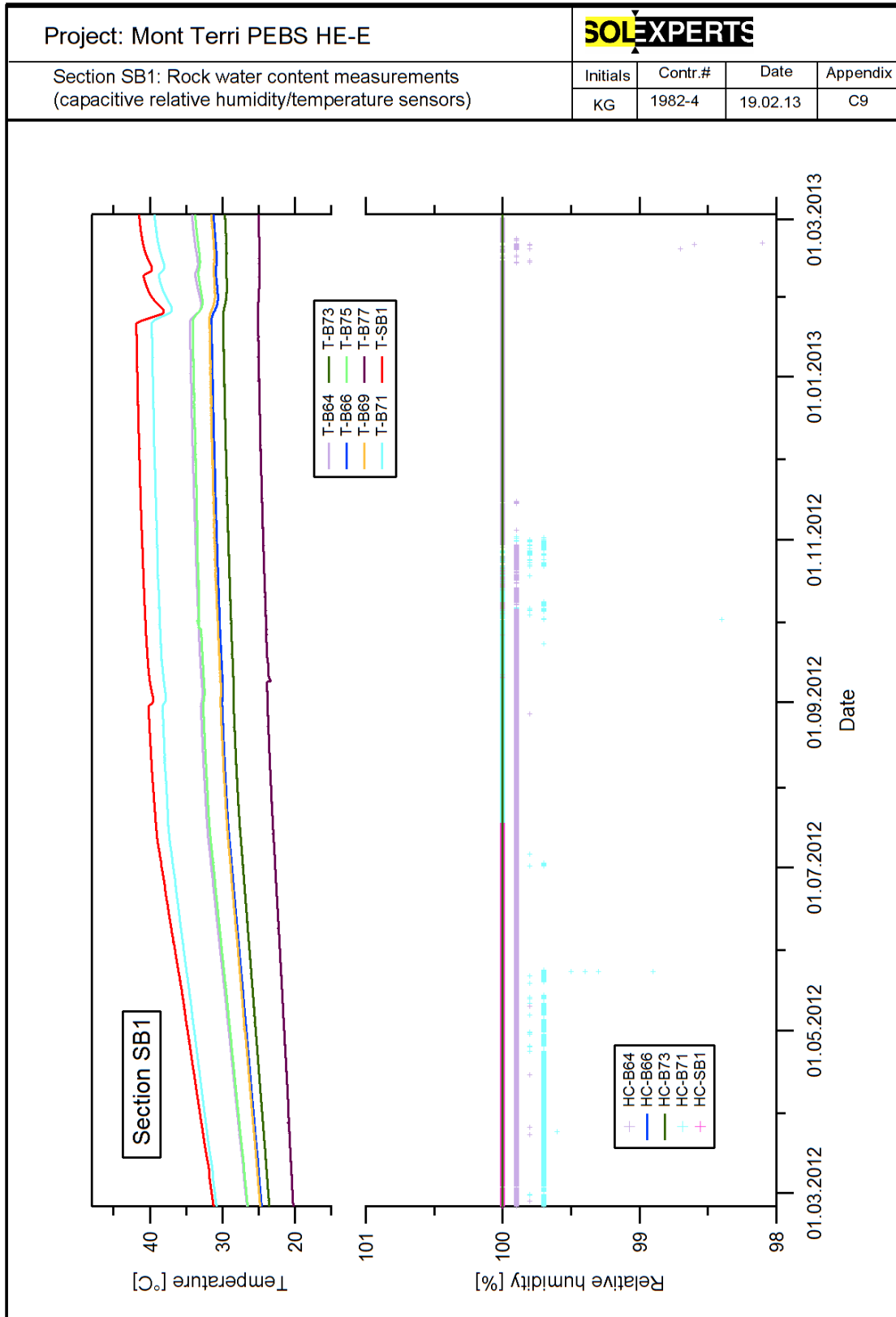


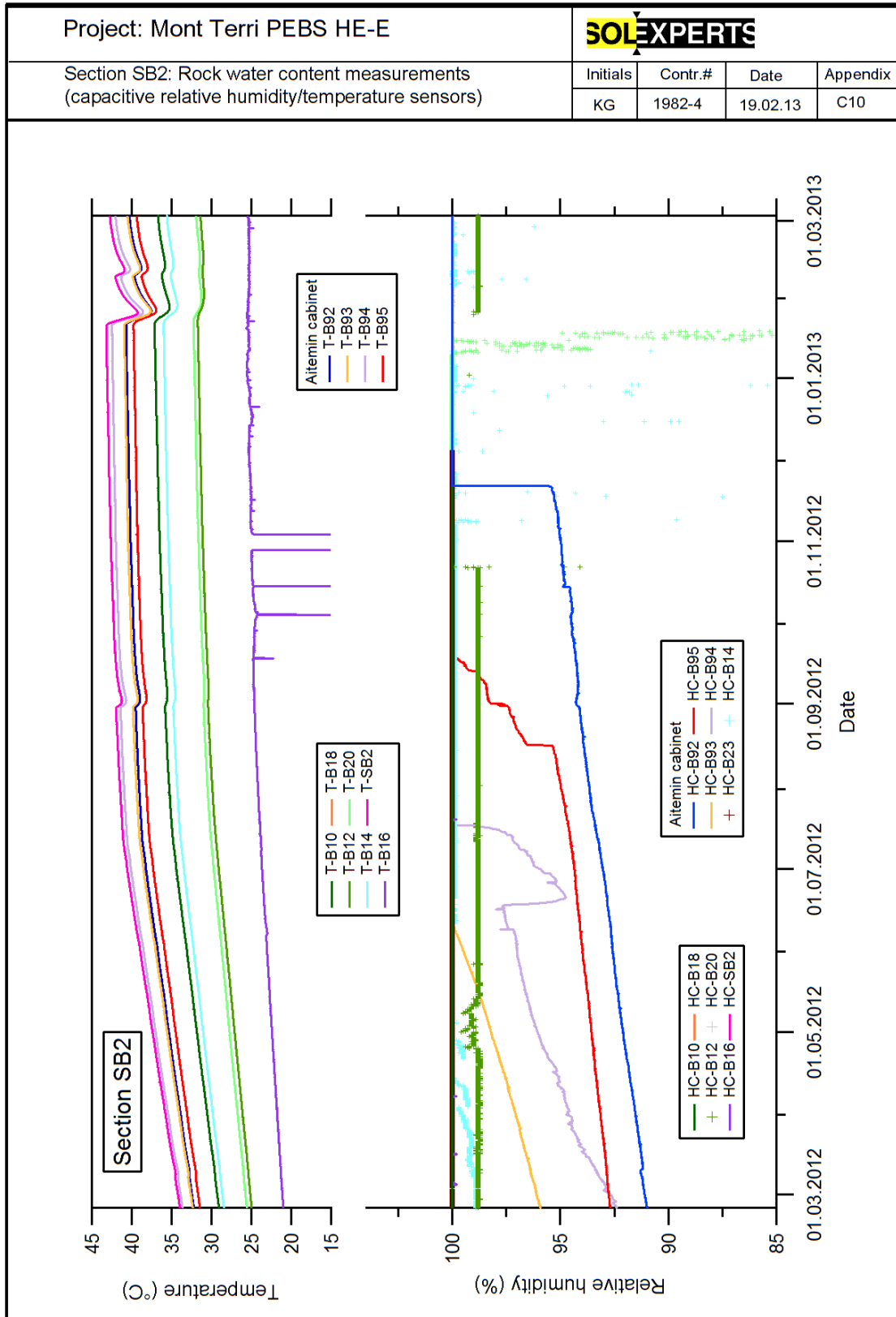


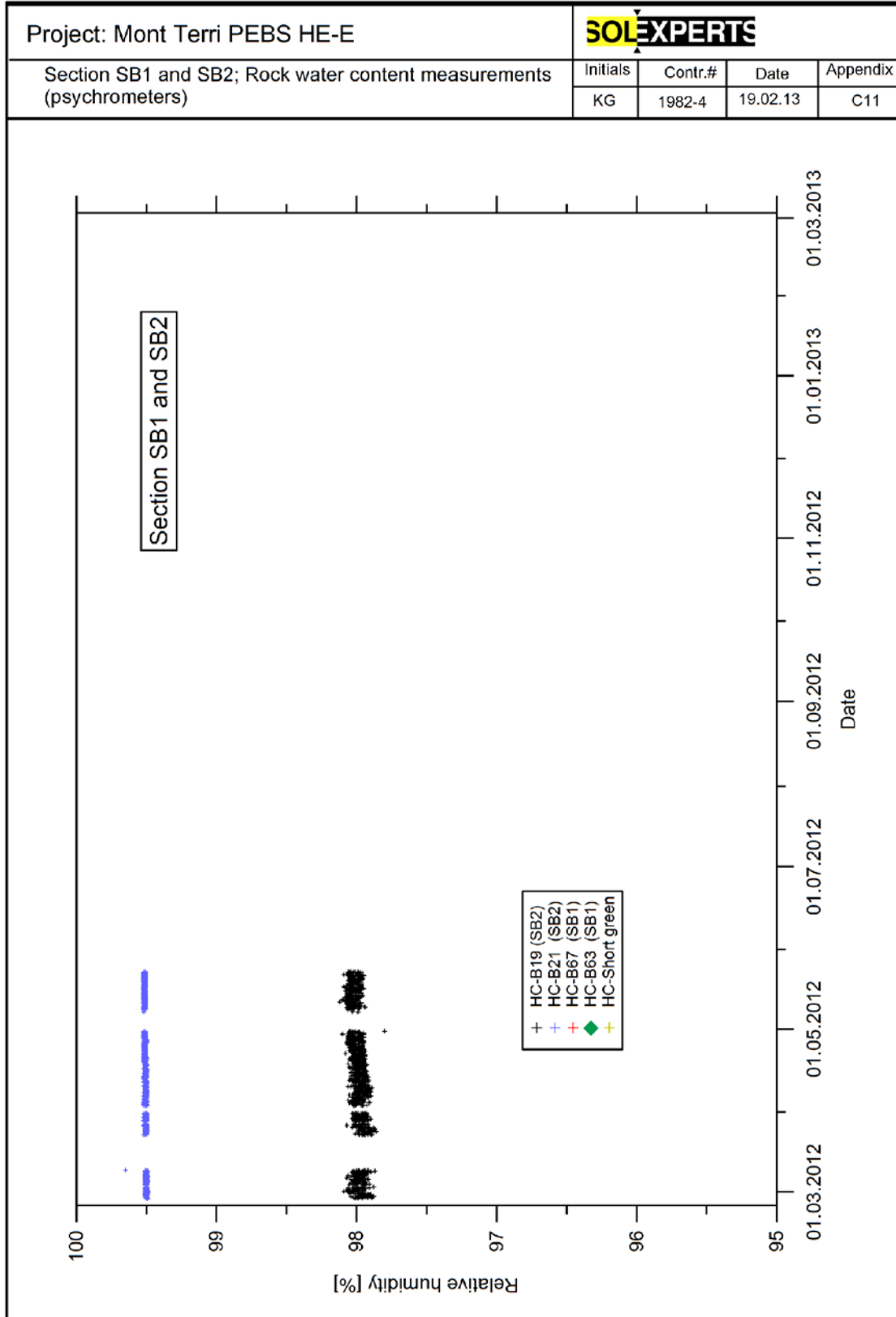






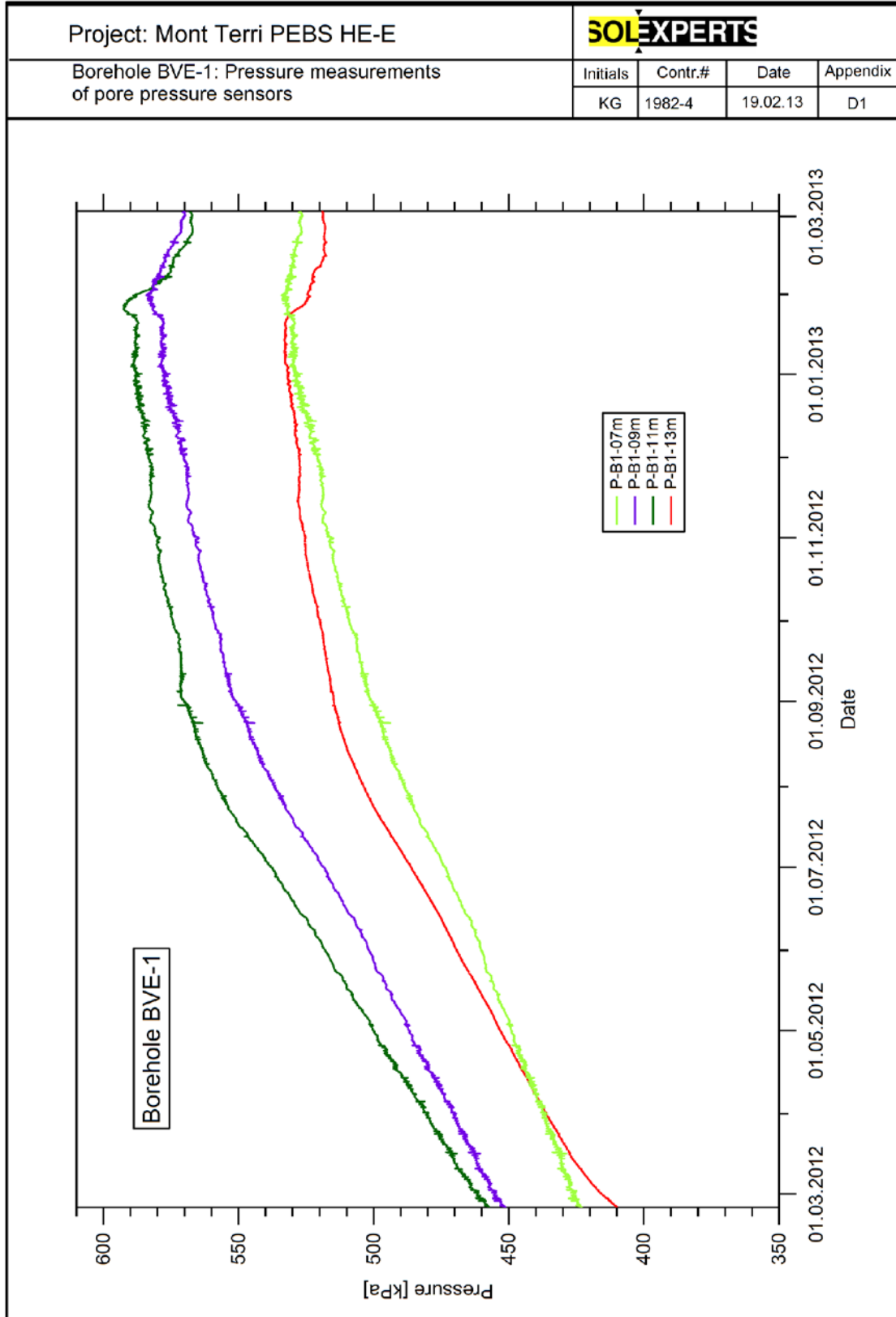


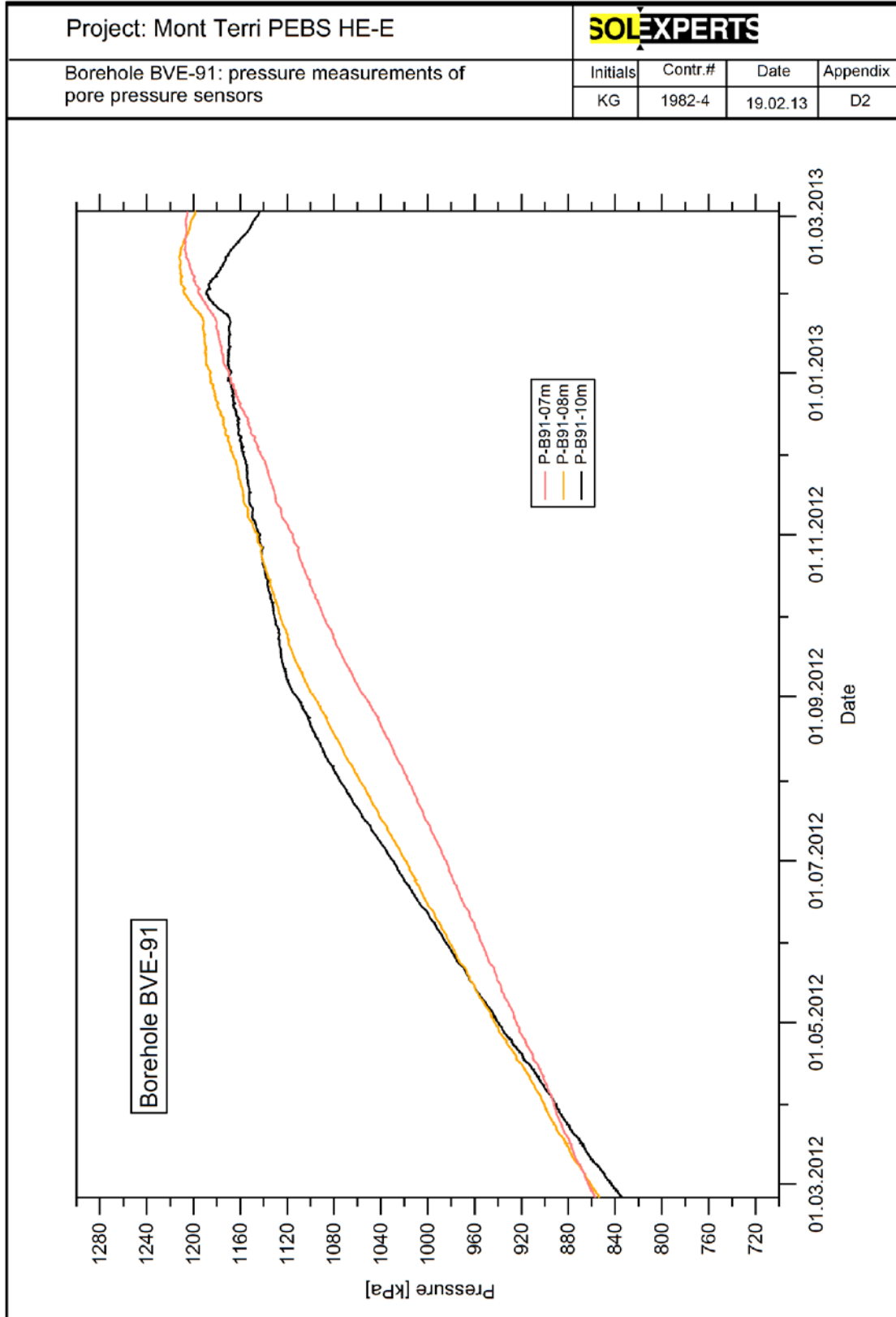


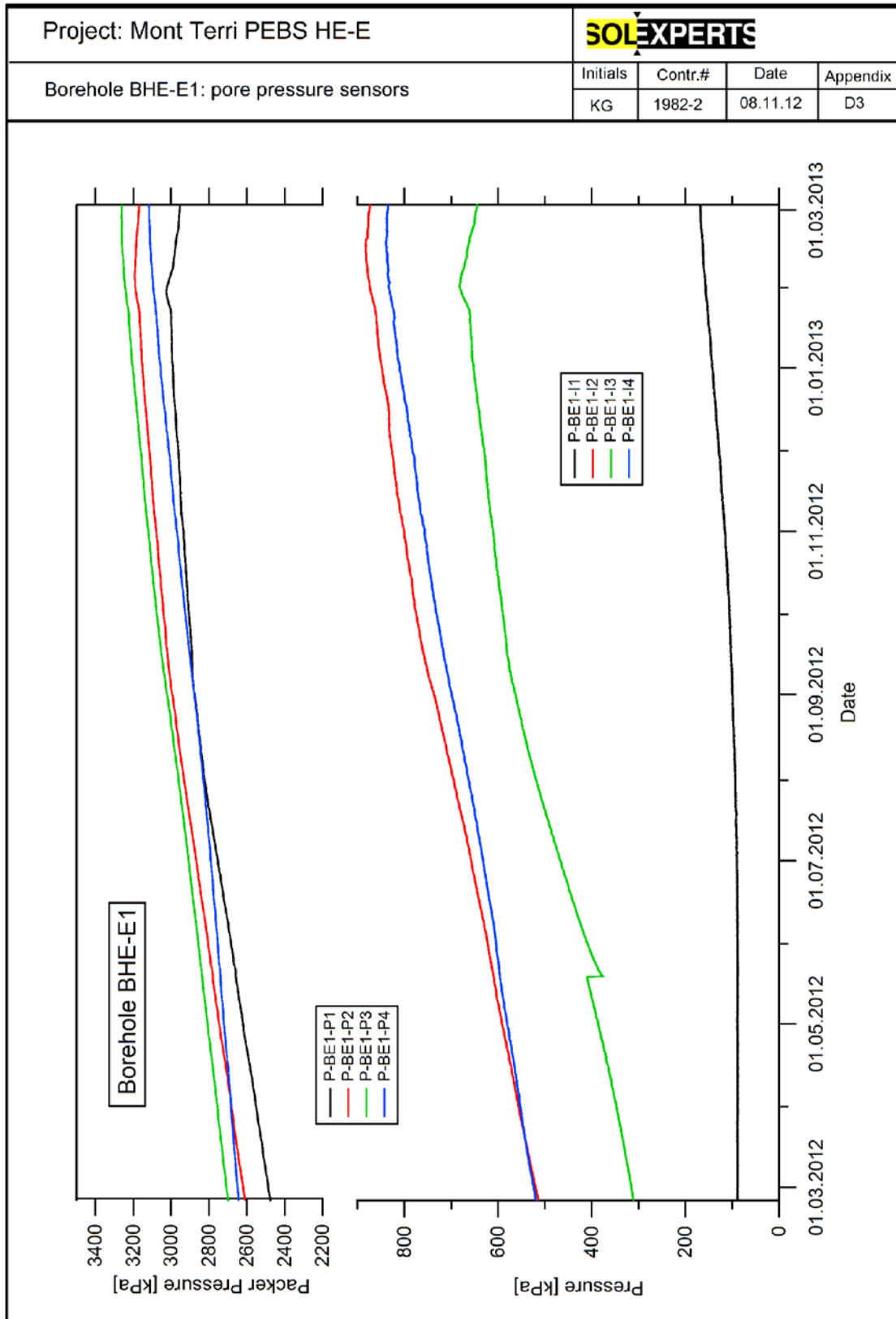


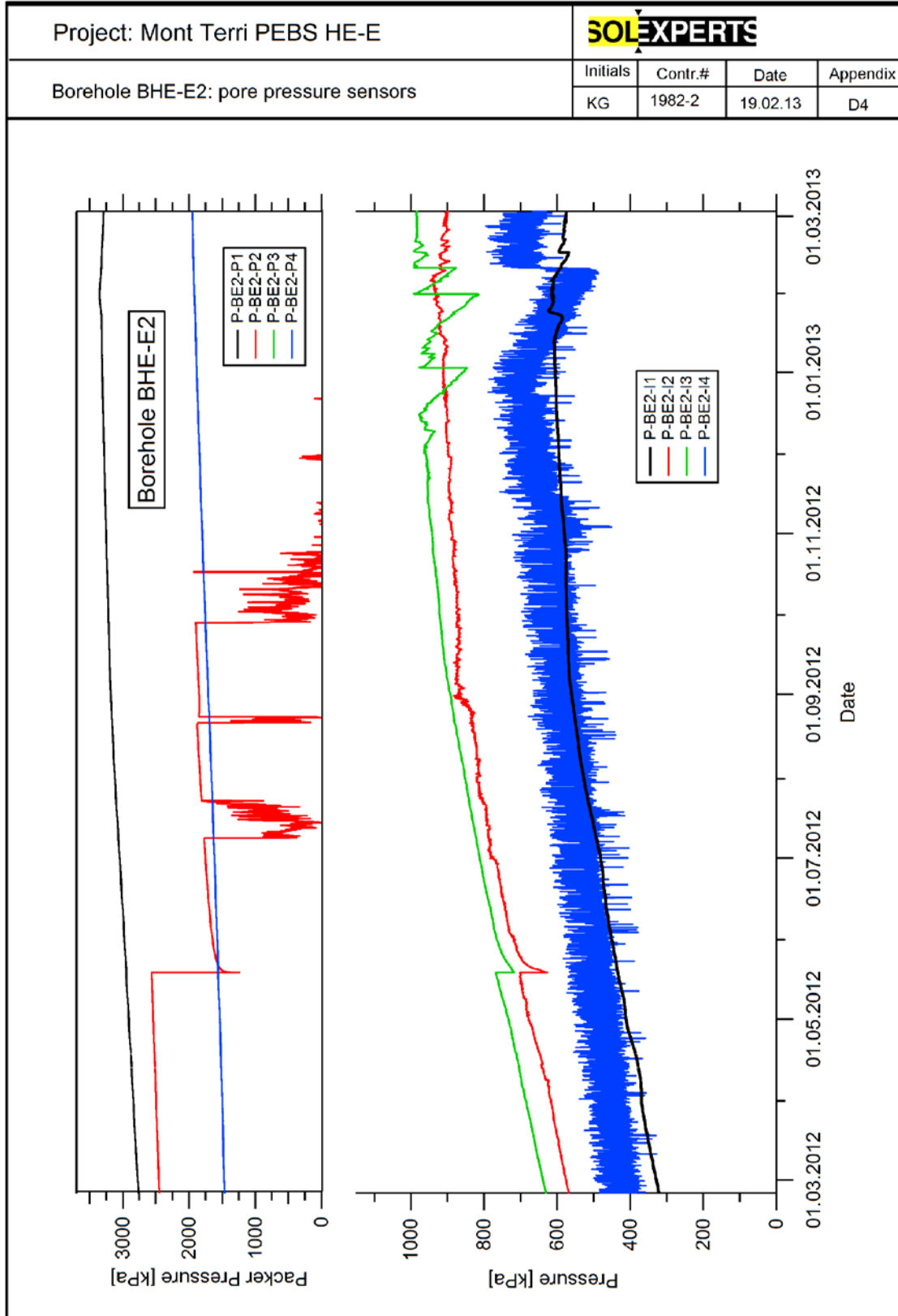
Appendix D:

- *Data plots of the sensors in the boreholes from Gallery 98*









Appendix E:

- *Data plots for the sensors installed in the EBS and at the EBS-host rock interface*

