Improved Management of Contaminated Aquifers by Integration of Source Tracking, Monitoring Tools and Decision Strategies

A.4.3. Direct push methods - local assistance

Final report

Geological Survey of Slovenia
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1 Introduction

Research of groundwater resources in the frame of INCOME project is taking place on the area of Ljubljansko polje and Ljubljansko barje. Main objective of the project is long-term effective management of aquifers and preservation of the quality of these water resources for future generations. The INCOME Project (LIFE07 ENV/SLO/000725) is co-financed by European Commission, Municipality of Ljubljana and Ministry of the Environment and Spatial Planning of Republic of Slovenia.

Researches with Direct-push technology took place in Ljubljansko barje, on drinking water protection area of the Brest abstraction field, between 14th and 24th of June 2010. Second and third (the last) investigation campaign with Direct-push technology took place also in Ljubljansko barje on drinking water protection area of the Brest abstraction field (second between 20th and 29th of October 2010 and third between 24th and 28th of October 2011).

Direct-push technology is minimal invasive method. The small diameter monitoring wells are capable of providing the support for a large variety of devices designed to measure the groundwater elevation, the presence and thickness of an eventual contamination body and to sample the groundwater. Direct-push technology was implemented by Geo-log and Geological Survey of Slovenia as assistance on the field.

2 Determination of potential locations

Determination of potential locations for method implementation was prepared on foundation of limitations and most suitable locations, parcels in Ig Municipality ownership (mostly field paths and some parcels). Less suitable areas represent land in private ownership, predominantly agricultural land (fields and gardens). Unsuitable areas represent built-up and similar areas, roads, and land on the area of economic and public infrastructure. For complete description of hydrogelogical characteristics, 52 well locations were selected. Among these 52 locations were 16 priority locations and 36 optional locations.

For the purposes of obtaining permits, a meeting with Ig municipality mayor was organized. An agreement was made in which the mayor expressed support to our research activities. Assurances of permits were provided with help of Ig municipality mayor, who also organized a meeting with land owners in Ig municipality, where we also participated. Response and participation of land owners on the meeting was poor, but we managed to get three permits in the area outside water abstraction field. Other locations were located on the middle of the field paths, with permit of Ig municipality mayor.

3 Direct-push technology

In the year 2007, the Direct-push (DP) technology was tested in Ljubljansko polje and Ljubljansko barje. Tests showed applicability of the technology on Ljubljansko barje. Regarding results from the testing of the DP technology in the year 2007, in June 2010, October 2010 and October 2011, its implementation took place on drinking water protection area of the Brest abstraction field.

The Direct-push (DP) technology was implemented by Geo-log, German INCOME partner. Geological Survey of Slovenia was providing assistance and guiding on the field work.

The Direct-push technology (such as implemented by e.g. Geoprobe), based on technology for geotechnical investigations is well accepted technique for subsurface investigation due to continuing development of the hammering/pushing equipment and the increasing variety of probes/well installations that can be applied.

Geo-log is using the DP technology, which employs high-frequency (~ 30 Hz) percussion hammers and hydraulic slide system available in track-mounted configuration (Figure 1). They offer the possibility of continuously recording investigation relevant parameter, sampling of the soil, soil gas and groundwater and installing groundwater or soil gas monitoring wells up to an inner diameter of 2 inches.

Figure 1: The direct-push technology equipment.

3.1 Electrical conductivity technique

On every location selected for installation of monitoring wells, firstly electrical conductivity (EC) logging was made. Electrical conductivity EC technique provides onsite, through a direct measure of the electrical conductivity of the underground, indirect information of the subsurface lithological characteristics (Figure 2). The EC technique is an excellent tool for rapid delineation of the underground heterogeneity. Through this method, vertical profiles of the electrical conductivity are derived in order to map thin layers that may be difficult to detect with traditional methods. On base of EC logging results, depth of monitoring well, position of screen section and screen depth was set.

Figure 2: Electrical conductivity technique measurements on the field work.

3.2 Natural gamma logging (NGAM)

Natural gamma logging was made with equipment from Robertson Geologging. All rocks contain small quantities of radioactive material. Certain minerals contain trace amounts of Uranium and Thorium, Potassium-bearing minerals will include traces of radioactive isotope of Potassium, which emit gamma radiation. This radiation is detected by scintillation. The measurement is useful because the radioactive

elements are concentrated in certain rock types e.g. clay or shales, and depleted in others e.g. sandstone or coal. (Robertson Geologging Winlogger Software Operating Manual, 2003).

Measurement is done with a sonde, which is slowly descending into the borehole. Sonde is calibrated on standardized API (American Petroleum Institute) standard.

Beside natural gamma also temperature and conductivity measurements are included.

3.3 Installation of observation wells

The probe rods with an expandable drive point are driven into the subsurface. At final depth, a certain type of screen and casing is installed as a permanent monitoring well and the probe rods are retracted to allow the groundwater to flow in. The small diameter monitoring wells are capable of providing the support for a large variety of devices designed to measure the groundwater elevation, the presence and thickness of an eventual contamination body and to sample the groundwater.

In the investigation area of drinking water protection area of the Brest abstraction field, final depth of the installed monitoring wells is 30 m. Materials for permanently installed monitoring wells are:

- 1” and 2” HDPE – high density polyethylene - well material as riser and screen (Figure 3);
- 55 µm mesh geo-membrane as filter protection against well clogging;
- bentonite-granulate as packer for the annular void around the installed well;
- cement pack for the last meter of the installation;
- street caps for the ground finish.

Figure 3: 2” HDPE – high density polyethylene - well material as riser and screen.

4 Observation wells

In the first field campaign piesometers were implemented with Direct-push technology on 8 locations, where 8 electrical conductivity logging were made and 11 monitoring wells were installed (Appendix 1). Electrical conductivity logging was made to the depth around 30 m and on the base of the logging results we decided in which depth we should put filter screen and how deep monitoring wells would be. On the first 3 locations (INC-1, INC-2 and INC-3) double monitoring wells were installed, one deep (D-end mark in the name) and one shallow from (S-end mark in the name) (Appendix 2, 3, 4, 5, 6, 7). These monitoring wells are in the area of water abstraction field Brest, protected with fence on alarm. On the other 5 locations (INC-4D, INC-5D, INC-6D, INC-7S and INC-8S) only one monitoring well per location was installed. They are installed on different depths (two around 15 m deep and others around 25 m deep) (Appendix 8, 9, 10, 11, 12). Monitoring wells are outside of water abstraction field of Brest in the middle of field paths and had to be equalized with the level of ground, therefore street caps and piesometer caps with padlock are installed (Meglič et al., 2010).

In the second field campaign observation wells were implemented with Direct-push technology in 10 locations (Appendix 1), where 12 2” monitoring wells (Table 1) were installed. Electrical conductivity logging was not implemented, while an unsolvable damage on the electrical probe occurred. To fill the sedimentation information deficit, we used Natural gamma logging (NGAM) technique in 11 observation

wells. On a figure below there is comparison between two results of the logging. The bigger peaks are indicating on sediments with larger content of clay and silt (Figure 4). NGAM logs also indicate on very heterogenic vertical and horizontal sedimentation in the Holocene aquifer with lenses (of different size) of low permeability.

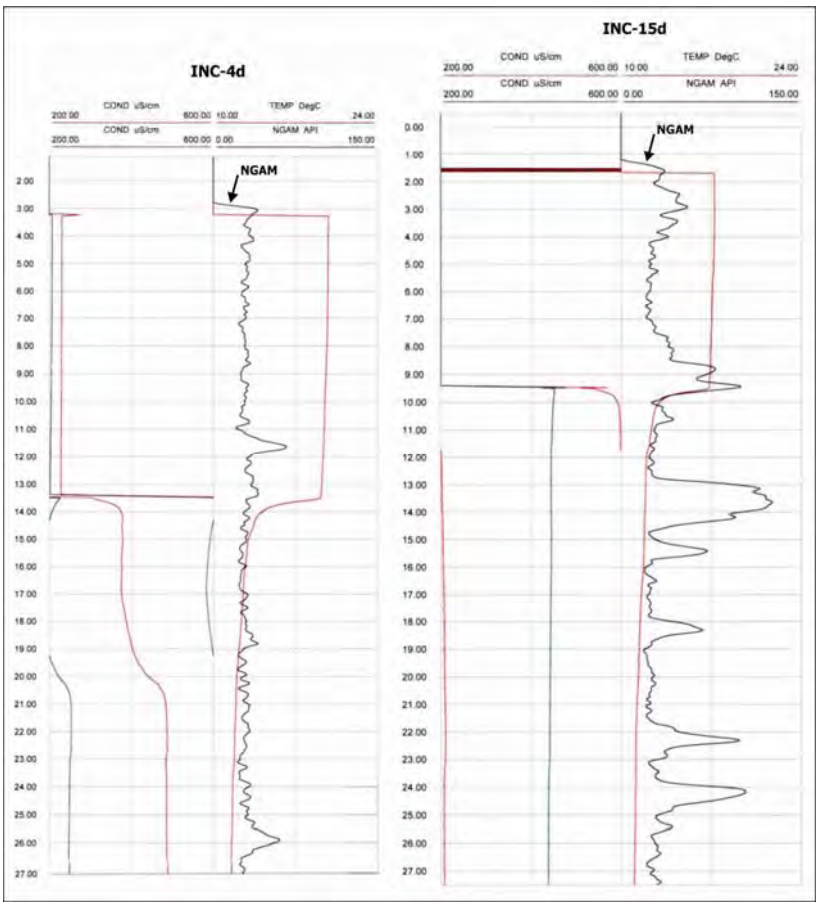


Figure 4: Comparison of two natural gamma logging (NGAM) results in the upper aquifer.

On 2 locations (INC-15 and INC-18) double observation wells were installed one deep (D-end mark in the name) and one shallow (S-end mark in the name) (Appendix 18, 19, 22, 24). On 8 locations (INC-10S, INC-11S, INC-12S, INC-13D, INC-14D, INC-16D, INC-17S and INC-19S) only one observation well per location was installed (Appendix 13, 14, 15, 16, 17, 20, 21, 25). Observation wells are in the middle of field paths and had to be equalized with the level of ground, therefore street caps and piesometer caps with padlock are installed (Meglič et al., 2011).

In the third (last) field campaign observation wells were implemented with Direct-push technology on 5 locations (Appendix 1), where 7 1" monitoring wells (Table 1) were installed. Electrical conductivity

logging was made to the depth around 30 m or more and on the base of the logging results we decided in which depth we should put filter screen and how deep monitoring wells would be.

On 2 locations (INC-31 and INC-33) double observation wells were installed one deep (D-end mark in the name) and one shallow (S-end mark in the name) (Appendix 27, 28, 30, 31). On 2 locations (INC-30D and INC-32D) only one observation well per location was installed (Appendix 26, 29). On the location INC-18, where already two observation wells were installed (deep and shallow), we installed another middle observation well, INC-18M (Appendix 23). All three observation wells are designed to cover with screens different depths. Observation wells are in the middle of field paths and had to be equalized with the level of ground, therefore street caps and piesometer caps with padlock are installed (Meglič et al., 2011).

Figure 5: Observation well installed on the field path with street cap and piesometer cap with padlock.

Table 1: Observation wells installed with Direct-push technology with coordinates and some technical information.

Piesometer name	Field altitude in meters
INC-1D	302,69
INC-1S	302,72
INC-2D	301,01

Piesometer name	Field altitude in meters
INC-2S	301,10
INC-3D	300,35
INC-3S	299,31
INC-4D	309,65
INC-5D	305,62
INC-6D	297,47
INC-7S	305,94
INC-8S	303,15
INC-07	298,81
INC 10S	311,18
INC 11S	306,06
INC 12S	302,05
INC 13D	299,32
INC 14D	301,31
INC 15S	300,89
INC 15D	300,90
INC 16D	312,70
INC 17S	304,59
INC 18D	297,91
INC 18S	297,94
INC 19S	298,08
INC-30D	308,28
INC-31D	300,62
INC-31S	300,60
INC-32D	294,58
INC-33D	307,82
INC-33S	307,81
INC-18M	297,92

Connection between surface water of river Iška and groundwater in the area (groundwater in Holocene gravel aquifer of Iška fan) is for this area also important. Thus we installed 4 piesometers (Table 2, Appendix 1), which are 1 meter long, in the river bed of Iška on the section from Iška vas to Tomišelj. Unfortunately in the last flood event in the September 2010, two (INC-20 and IN-21) had been washed away.

Table 2: Observation wells installed in river Iška.

Piesometer name	Top of casing altitude in meters
INC-9	301,723
INC 20	303,917
INC 21	307,790
INC 22	314,230

Measurements of coordinates and altitude values were made with GPS method with accuracy of 3 cm. Measurements of all 19 monitoring wells are made by special department for geodetic measurements on VO-KA.

5 Measurements and sampling of groundwater

In this report we represent only results of groundwater level measurements.

Measurements of groundwater level were carried out 14 times in one day period to cover the same water conditions. Groundwater levels were measured in varying number of observation wells, only the last two measurements were carried out on all. Last measurement of groundwater levels on 22nd of November 2011 covered even larger area. Two teams of VO-KA (public company Vodovod-kanalizacija) and GeoZS were measuring groundwater levels in new observation wells and old piesometers on which the measurements are constantly performed by VO-KA.

In this report we represent only results of the last two campaigns of groundwater level measurements. Results are in the table below (Table 3) and interpolation results in Appendix (Appendix 32).

Table 3: Measurement results of groundwater level.

Observation well	4.11.2011 – Groundwater level (altitude in m)	22.11.2011 – Groundwater level (altitude in m)
INC-1D	289,6	290,0
INC-1S	289,5	290,0
INC-2D	290,0	289,5
INC-2S	290,2	289,6
INC-3D	294,5	293,2
INC-3S	295,2	293,8
INC-4D	295,7	294,6
INC-5D	292,5	292,5
INC-6D	289,0	289,1
INC-7S	291,9	292,6
INC-8S	298,8	296,1
INC-07	290,2	289,0
INC 10S	302,4 *	296,9
INC 11S	291,0	291,2
INC 12S	289,6	290,0
INC 13D	289,5	289,5
INC 14D	289,3	289,5
INC 15S	289,6	289,8
INC 15D	289,6	289,8
INC 16D	300,5	300,4
INC 17S	293,2	292,8

Observation well	4.11.2011 – Groundwater level (altitude in m)	22.11.2011 – Groundwater level (altitude in m)
INC 18D	289,1	289,3
INC 18S	289,1	289,3
INC 19S	292,2	290,7
INC-30D	294,1	-
INC-31D	290,3	290,0
INC-31S	289,5	290,1
INC-32D	288,9	288,8
INC-33D	303,9	302,2
INC-33S	304,1	302,4
INC-18M	-	289,4

* ... measurement is not reliable

After finishing the implementation of Direct-Push technology, cleaning of monitoring wells was made by a firm from Maribor with air lift technology. Some cautions were needed, while the construction of wells is quite delicate, because of gauze around screen section which can be easily damaged. The pressure of air impressing had to be carefully controlled. All monitoring wells were cleaned in one day.

After finishing the third implementation of Direct-Push technology, cleaning of monitoring wells was made by GeoZS, while observation wells have 1" diameter.

Last sampling of the groundwater in observation wells was performed by GeoZS on 13th, 19th and 20th December 2011 with 2 inch Teflon pump (in the 2 inch inner diameter observation wells) and with the bottom valve low-flow system (in the 1 inch inner diameter observation wells). Samples for Nitrate analysis were taken on 29 locations, for Pesticide on 24 locations, for Volatile organic compounds (VOC) 5 locations and for basic chemistry on 7 locations. Before taking the sample, there was performed pre pumping of water. Amount of pre pumped water was one time of volume of piesometer. Samples were sent to VO-KA laboratory for concentration analysis.

Results and interpretation of chemical analysis are represented in The INCOME Project in actions A.2.7 and A 4.1.

6 Conclusions

Direct-push technology was implemented on south-eastern part of Ljubljansko barje (water protection area of the Brest abstraction field) on 23 locations, where 31 observation wells (piesometers) were installed in all three campaigns. On 16 locations one observation well was installed. On 6 locations double and on 1 location three observation wells were installed.

In the first campaign, on 8 locations (8 electrical conductivity logging) 11 2" monitoring wells were installed. On 3 locations double (one deep and one shallow) observation wells were installed and on 5 locations 1 observation well. Depth of the observation wells is from 15 to 30 meters. Electrical conductivity logging was made on all locations to the depth around 30 m.

In the second and third (the last) campaign on 15 locations 20 1" and 2" observation wells were installed. On 3 locations double (one deep and one shallow), on 1 location 3 (one deep, one shallow and one in the middle) observation wells were installed and on 11 locations 1 observation well. Depth of the observation wells is from 16 to 30 meters. Electrical conductivity logging was made on 4 locations to the depth around 30 m and natural gamma logging on 11 observation wells.

Observation well casings and screens are constructed from HDPE material, which is safe for groundwater and drinking water quality. On the bottom is a plug and on the top well cap is installed. Observation wells installed outside of water abstraction field of Brest in the middle of field paths had to be equalized with the level of ground, therefore street caps and piesometer caps with padlock are installed. Seven observation wells are installed inside the area of water abstraction field Brest, protected with fence on alarm.

Electrical conductivity (EC) logging and natural gamma logging are indicating very heterogenic sedimentation in the area of Iška fan (water protection area of waterworks Brest). From the western part (river Iška) towards east (Ig, Kot) and North-east (Iška Loka) there is an increasing content of silt and clay in the gravel and also increasing number of clay and silt lenses. Clay and silt lenses are 1 to 2 meter thick and are stretching at most 150 meters in horizontal directions. In the upper 8 to 10 meters less silt and clay content is established with EC logging.

Before first sampling of groundwater in piesometers, cleaning of piesometers was performed with air lift method. Sampling of a groundwater in the observation wells was performed with 2" Teflon pump and bottom valve low-flow system.

Groundwater levels measured on 22nd of November 2011 are around 0,5 meter higher as those measured on 4th of November 2011. According to the interpolated groundwater level contours, general groundwater flow is to the north and in the waterworks Brest area influence of groundwater abstraction is evident.

7 Acknowledgment

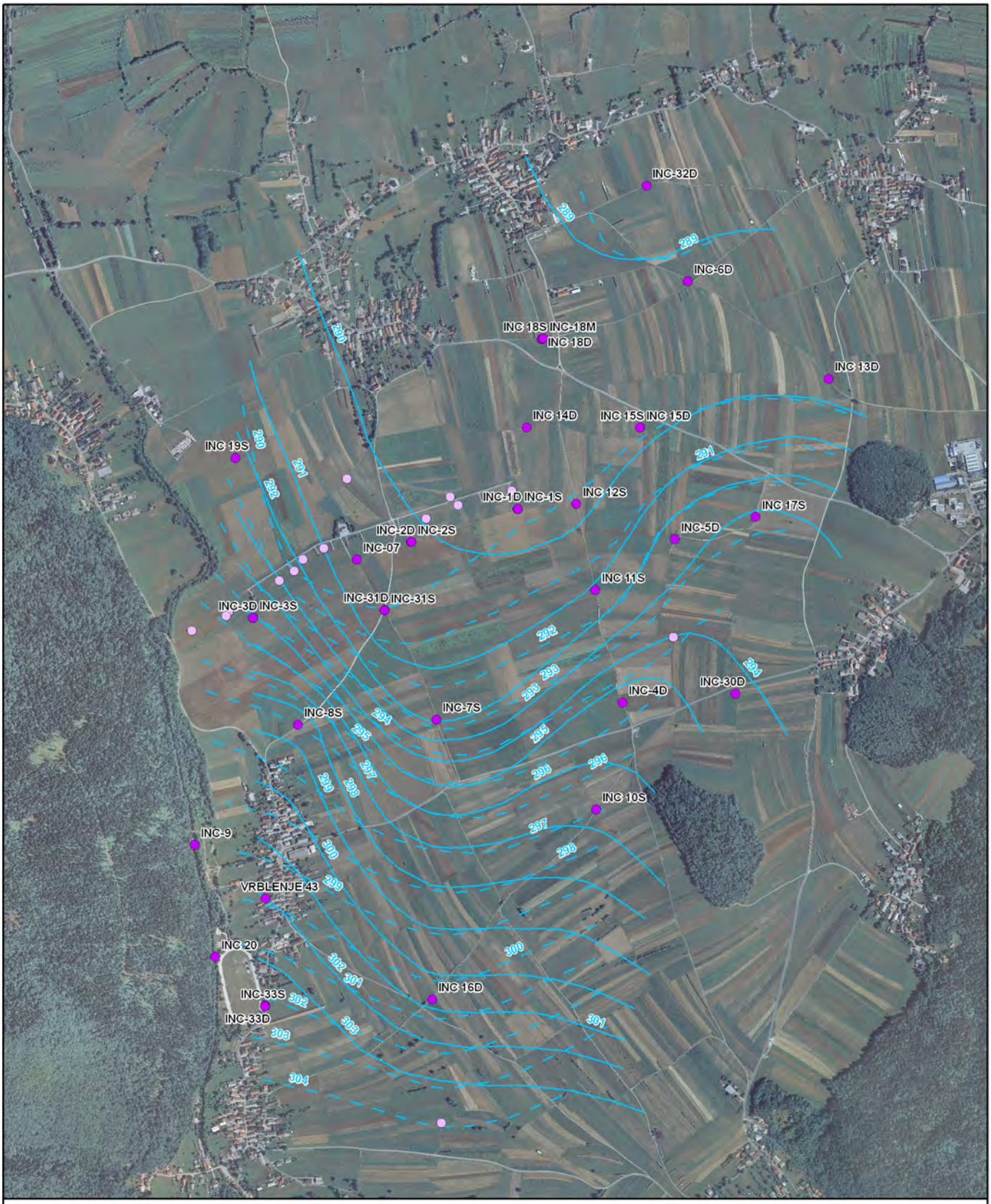
We would like to acknowledge the support of Ig Major for permits assurance and laboratory of VO-KA for quick groundwater sample analysis.

8 References

Meglič P, Janža M, Šram D, Prapertnik M (2010) A.4.3. Direct Push methods – local assistance. Installation of monitoring wells with Direct-Push technology and measurements. Geological Survey of Slovenia, Ljubljana.

Meglič P, Janža M, Šram D, Prapertnik M (2011) A.4.3. Direct Push methods – local assistance. Installation of monitoring wells with Direct-Push technology and measurements. Final Report. Geological Survey of Slovenia, Ljubljana.

Robertson Geologging Winlogger Software Operating Manual (2003) Robertson Geologging Ltd, Digital Geologging Systems and Services. Deganwy, Conwy.



Map of groundwater levels

Legend

- Observation well (INCOME)
- Well / Observation well (VO-KA)
- 300 Groundwater levels (Date 22.11.2011)
- 300 Groundwater levels (Date 4.11.2011)

INCOME Water Care

Geological Survey of Slovenia

N

0 0.25 0.5 1 km

Data source:
GURS, 2006; GeoZS & VO-KA, 2011.

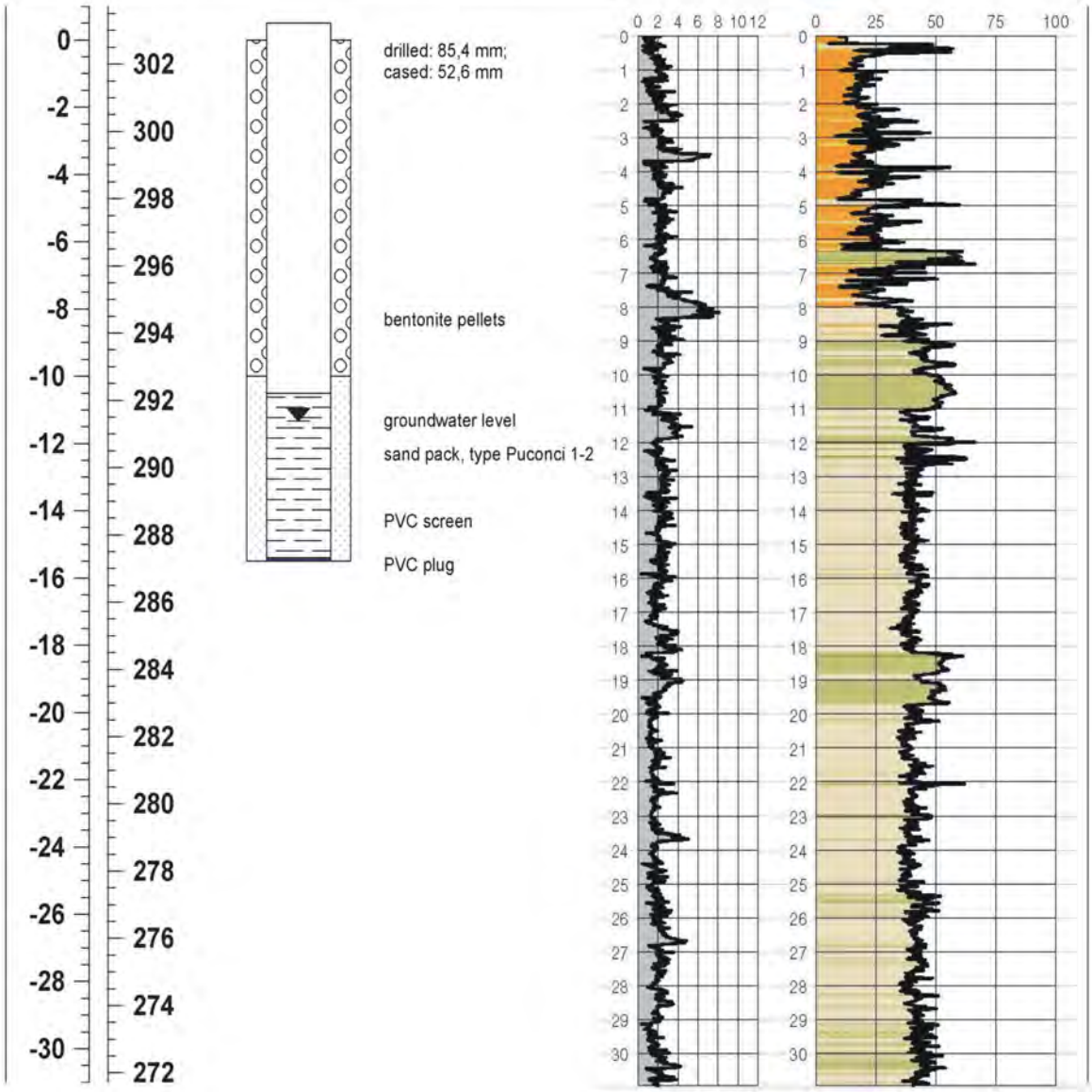
Digital cartography:
Meglič P., Šram D.

Appendix 32

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-1s	**Observation well**	**Direct Push method**	**14.6.2010**	**11,3 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **302,717**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)

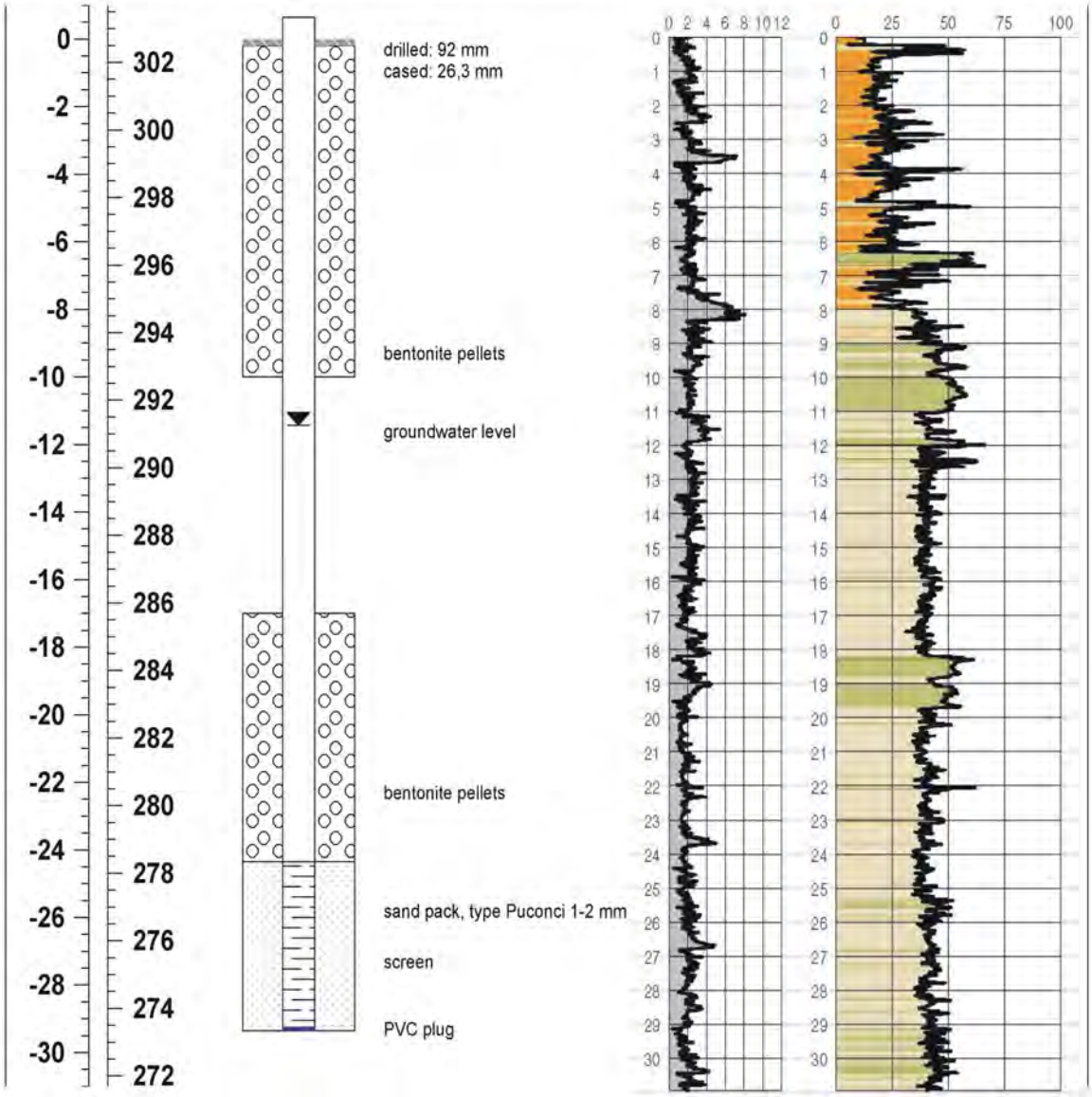


Object: **INC-1s**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **2**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-1d	**Observation well**	**Direct Push method**	**14.6.2010**	**11,43 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **302,690**	Top of Casing altitude: Z=



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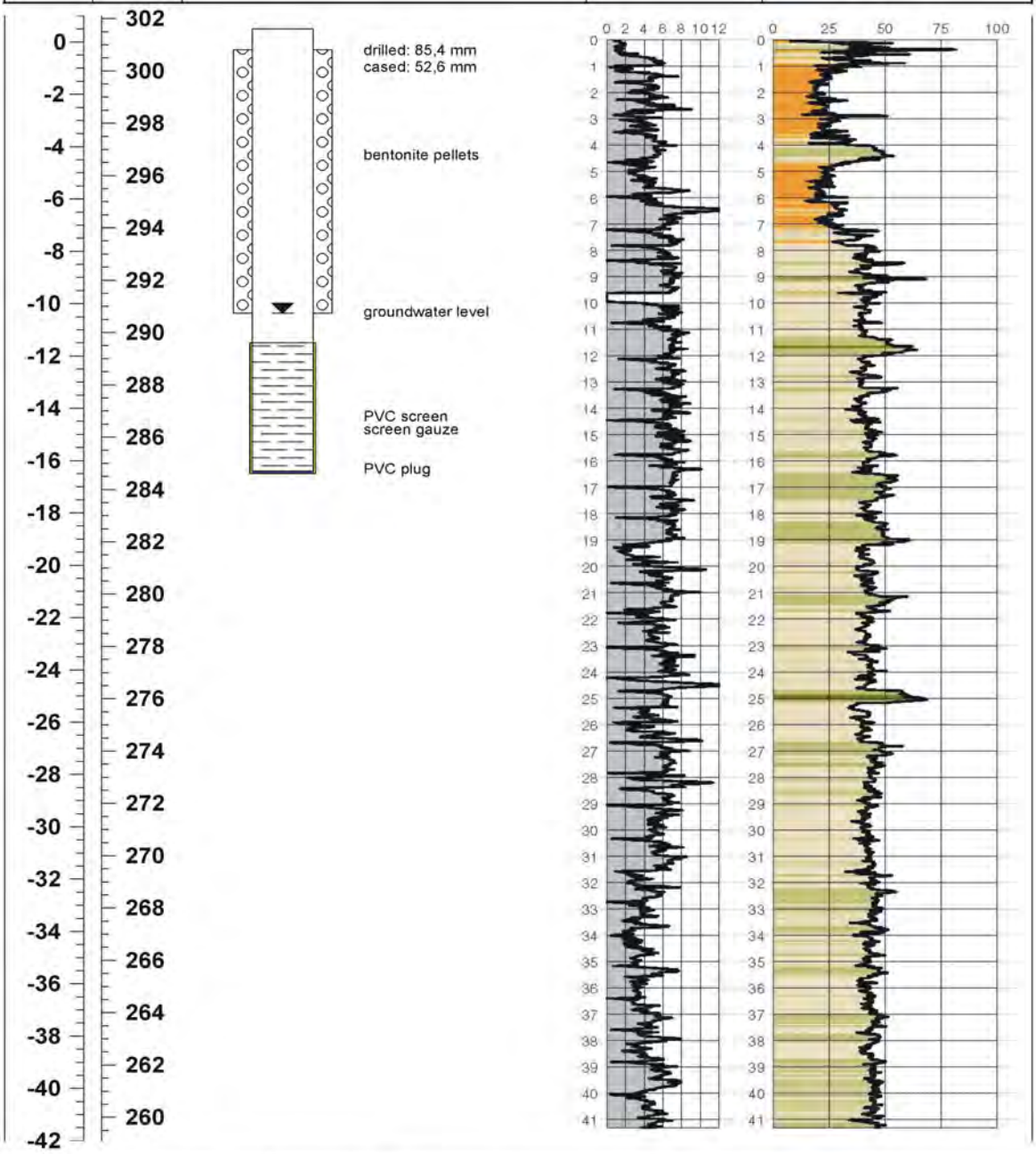
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **3**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-2s	**Observation well**	**Direct Push method**	**16.6.2010**	**10,37 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **301,104**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)



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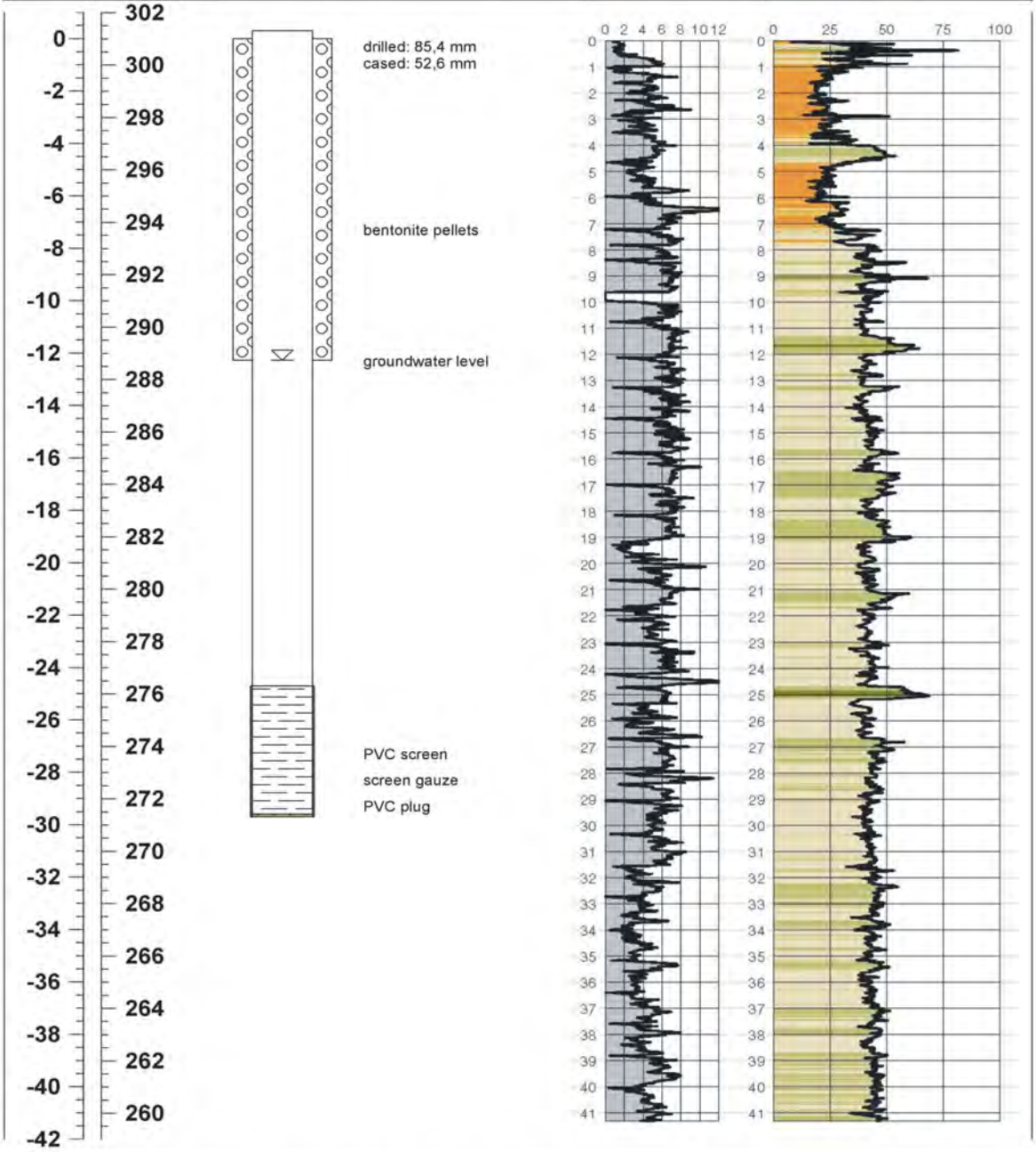
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical): **1:200**	Processed: **Meglič P., Šram D.**	
Appendix: **4**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-2d	**Observation well**	**Direct Push method**	**16.6.2010**	**12,27 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **301,012**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)

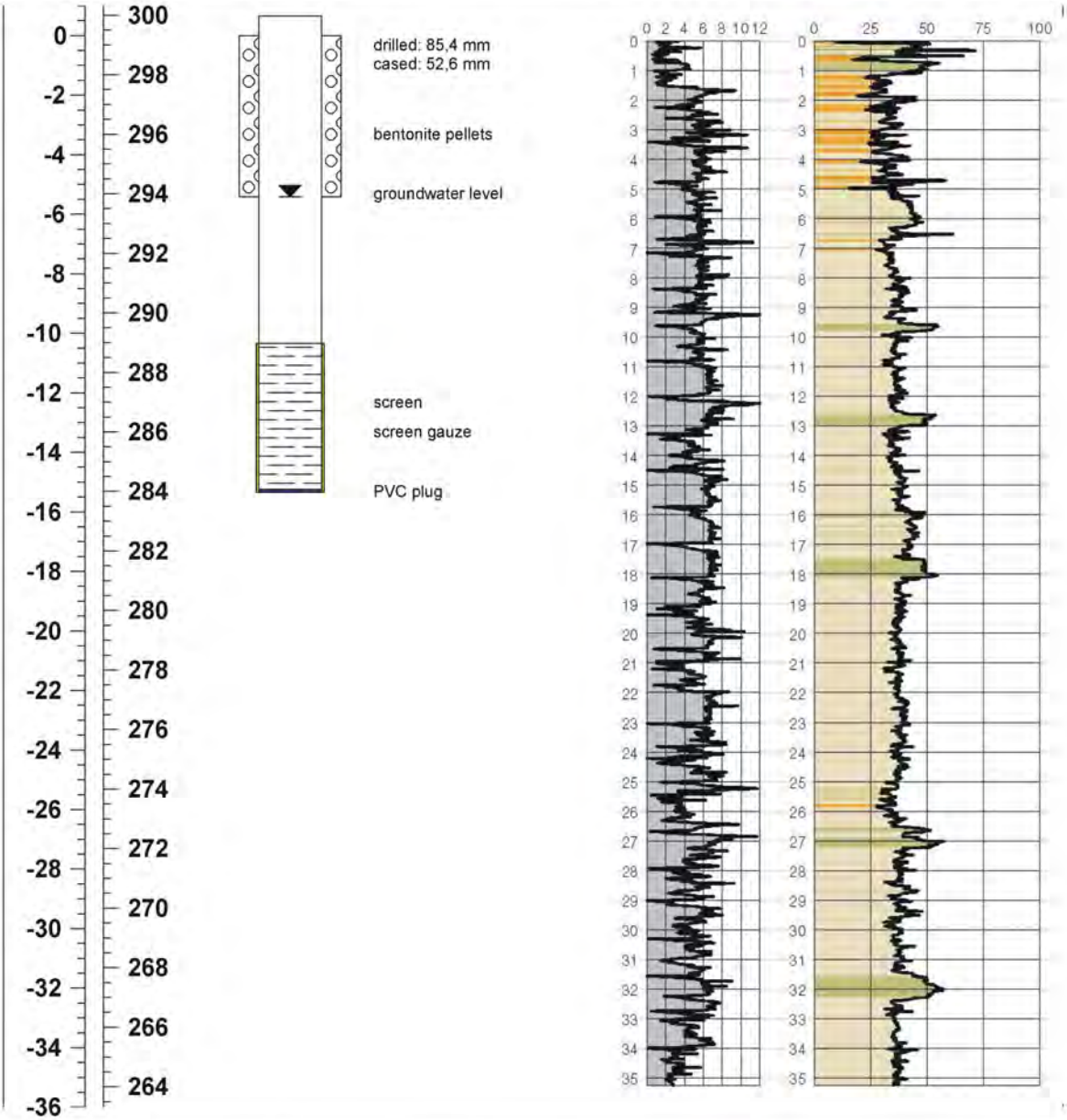


Object: **INC-2d**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	Electr. Conductivity [mS/m] — Interpretation
Scale (vertical):	Processed: **Meglič P., Šram D.**	0 - 30 GRAVEL - SAND 30 - 45 SAND, silty 45 - 60 SAND, very silty 60 - 80 SILT 80 - 200 SILT - CLAY > 200 not interpretable
Appendix: **5**		

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-3s	**Observation well**	**Direct Push method**	**16.6.2010**	**5,41 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **299,313**	Top of Casing altitude: Z=

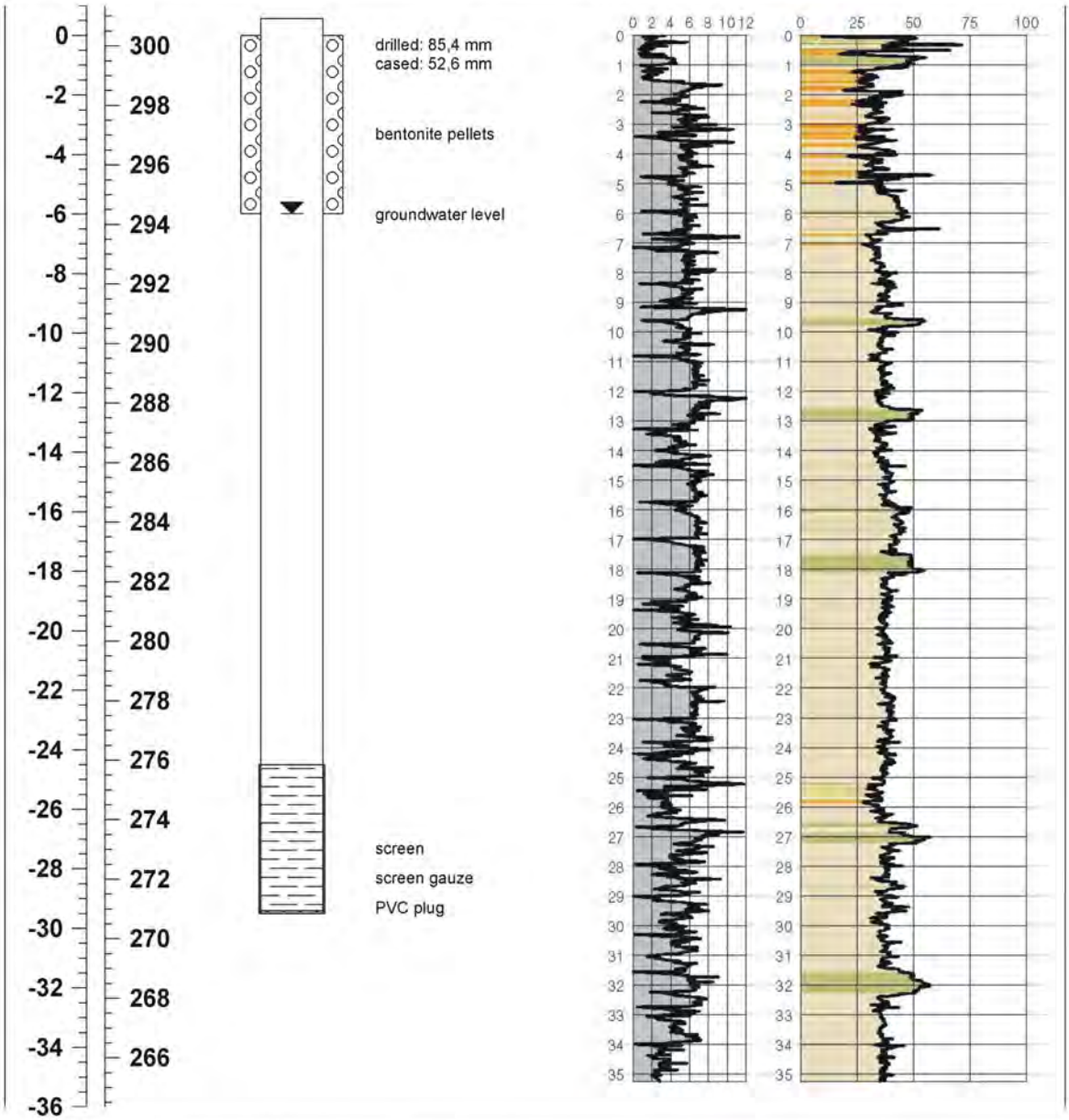
Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)



Object: **INC-3s**	Contractor:	Legende:	
Claimer:	**Geo-log, GmbH; University of Göttingen**	Electr. Conductivity [mS/m]	Interpretation
Scale (vertical):	Processed: **Meglič P., Šram D.**	0 - 30	GRAVEL - SAND
Appendix: **6**		30 - 45	SAND, silty
		45 - 60	SAND, very silty
		60 - 80	SILT
		80 - 200	SILT - CLAY
		> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-3d	**Observation well**	**Direct Push method**	**16.6.2010**	**5,98 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **300,349**	Top of Casing altitude: Z=



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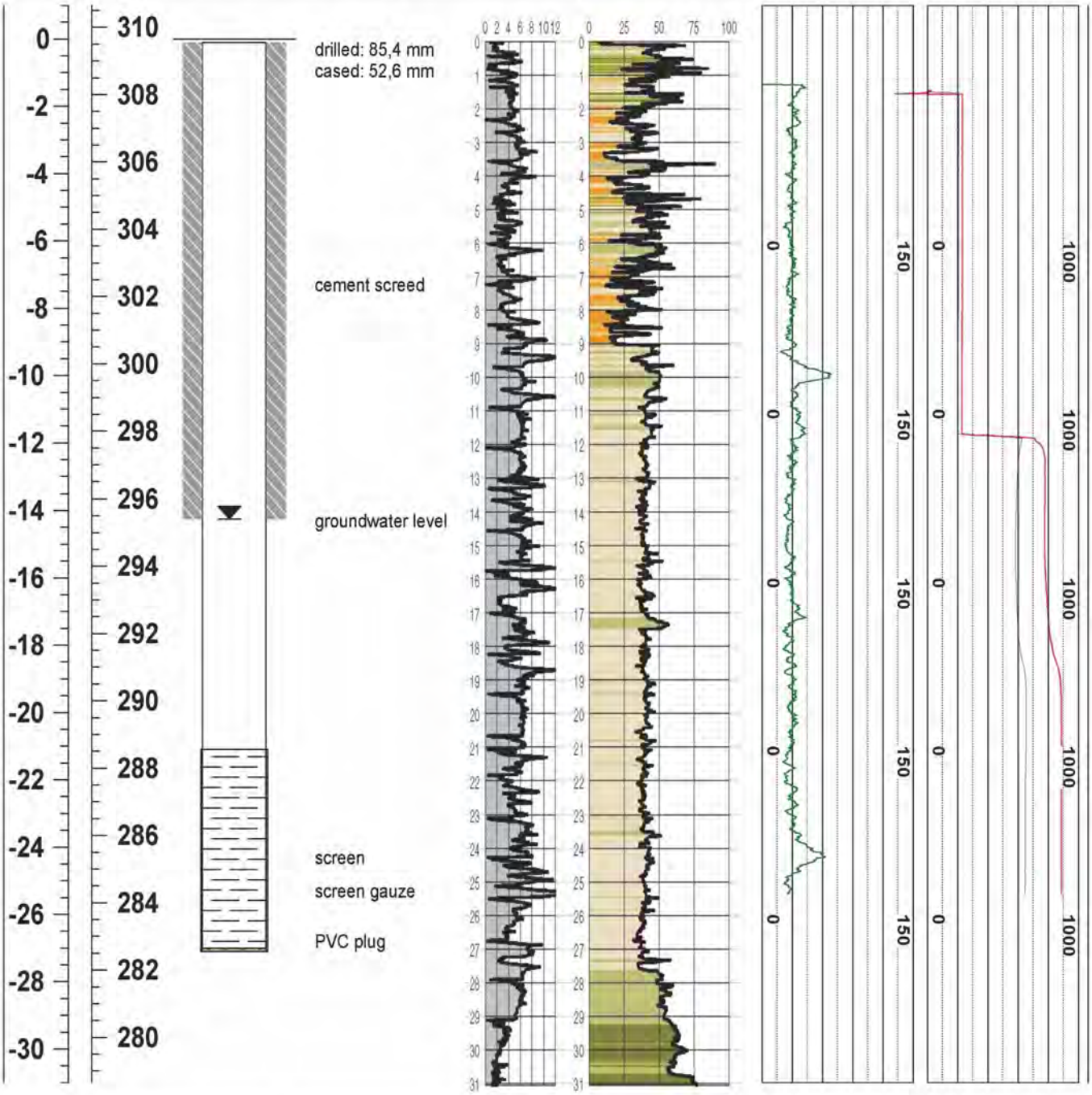
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **7**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-4D	**Observation well**	**Direct Push method**	**16.6.2010**	**14,25 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **309,653**	Top of Casing altitude: Z=

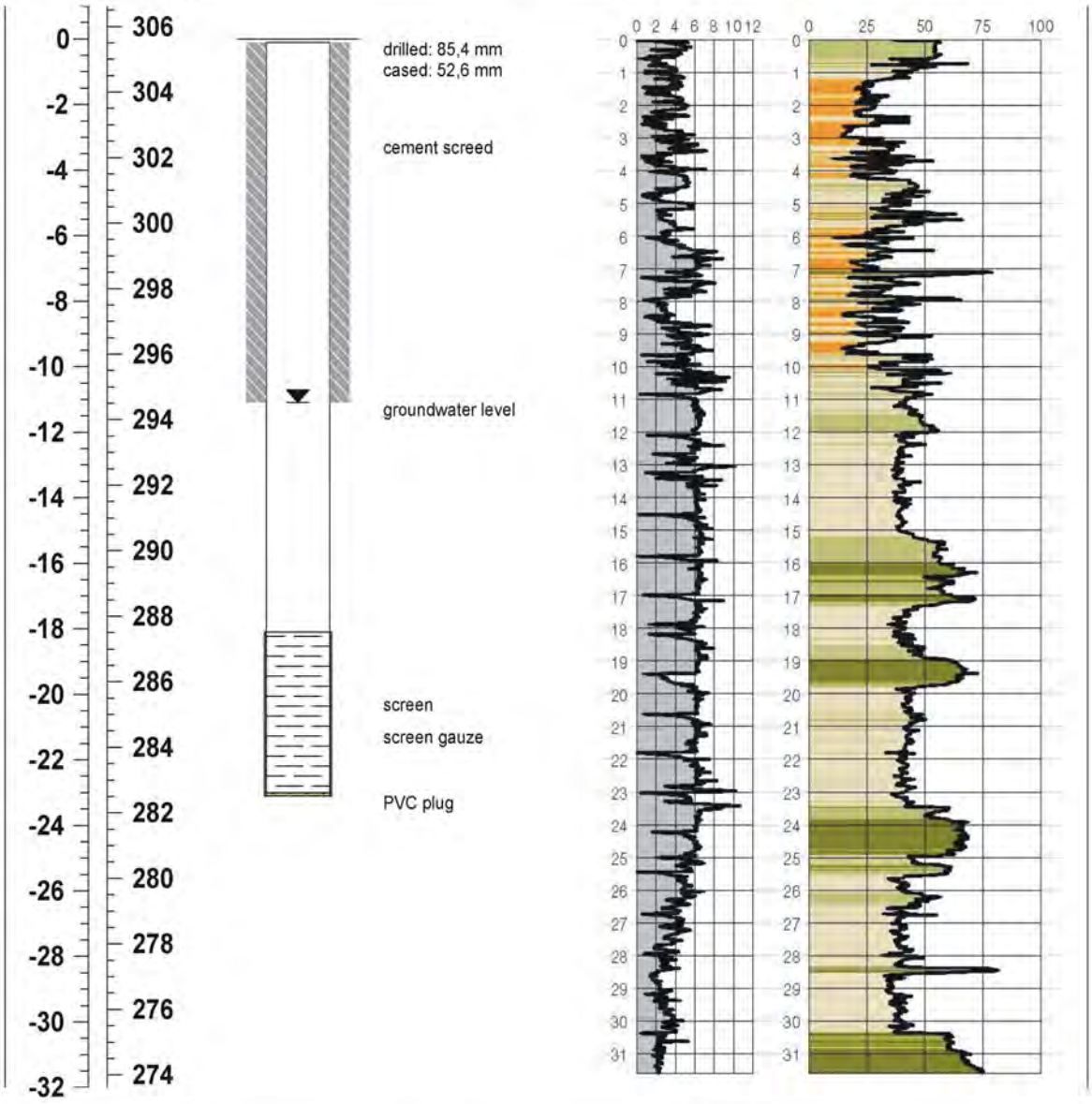


Object: **INC-4D**	Contractor:	Legend:
Claimer:	**Geo-log, GmbH; University of Göttingen**	Electr. Conductivity (mS/m) / Interpretation: 0 - 30 GRAVEL - SAND; 30 - 45 SAND, silty; 45 - 60 SAND, very silty; 60 - 80 SILT; 80 - 200 SILT - CLAY; > 200 not interpretable; Absolute Conductivity; Conductivity at 25 °C; (GeoZS, 2011)
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **8**	**Matoz, T.**	

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-5d	**Observation well**	**Direct Push method**	**21.6.2010**	**11,09 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **305,617**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)

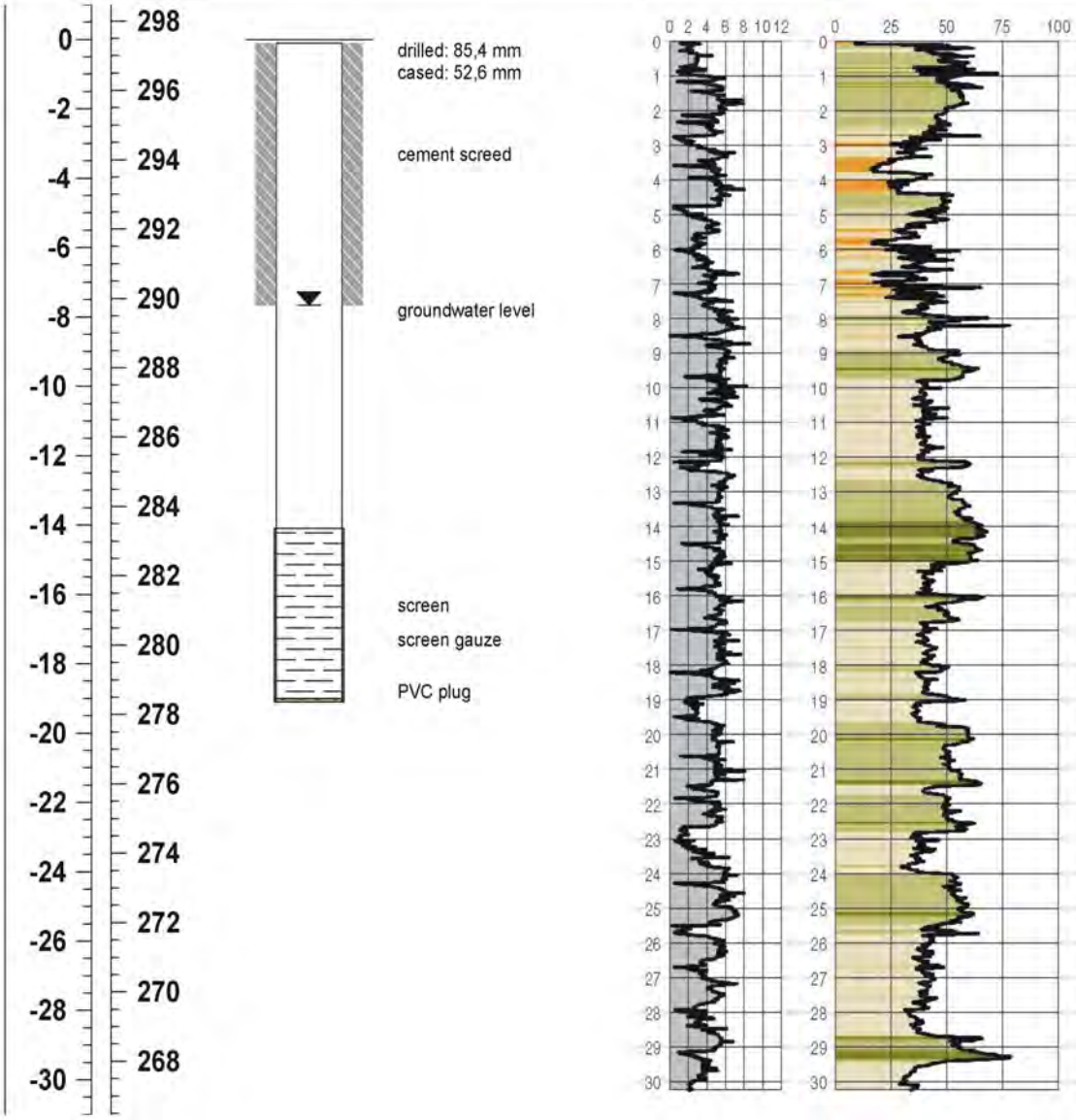


Object: **INC-5d**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **9**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-6d	**Observation well**	**Direct Push method**	**22.6.2010**	**7,66 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **297,465**	Top of Casing altitude: Z=



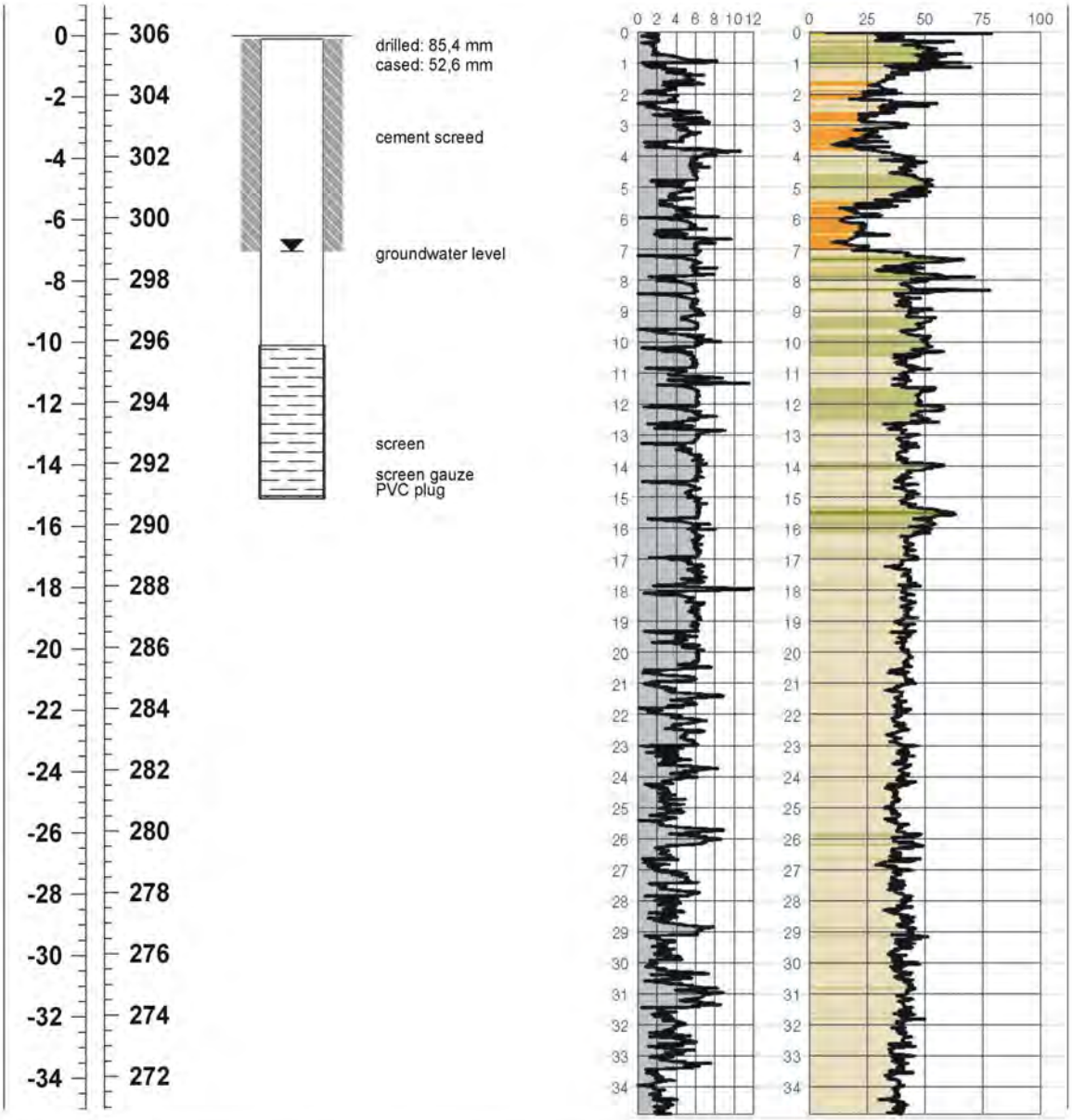
Object: **INC-6d**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **10**		

Electr. Conductivity (mS/m)	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-7s	**Observation well**	**Direct Push method**	**23.6.2010**	**7,03 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **305,938**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)



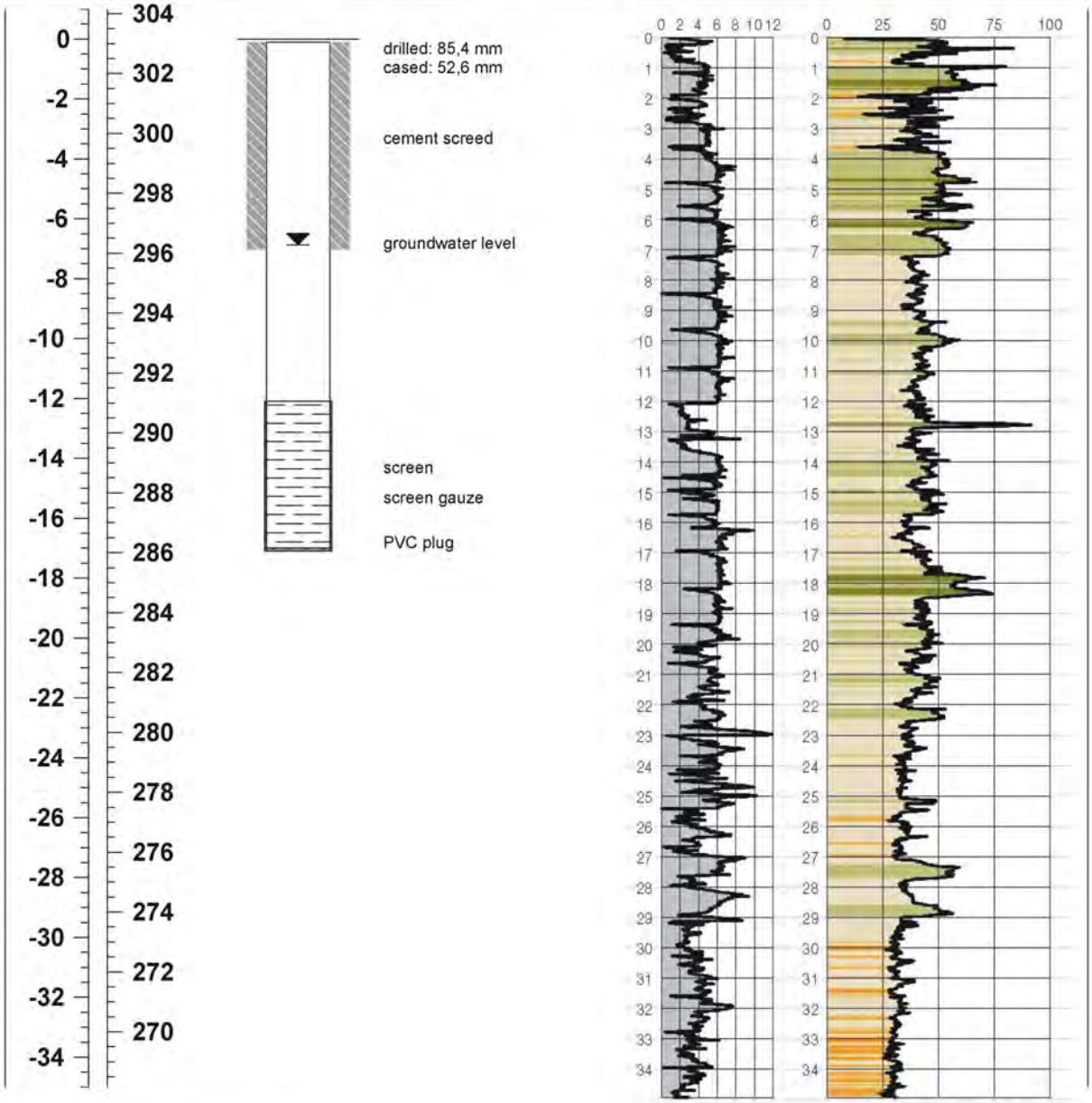
Object: **INC-7s**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **11**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-8s	**Observation well**	**Direct Push method**	**24.6.2010**	**6,87 m**
Location: **Brest**	X=	Y=	Field altitude: **Z= 303,151**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)



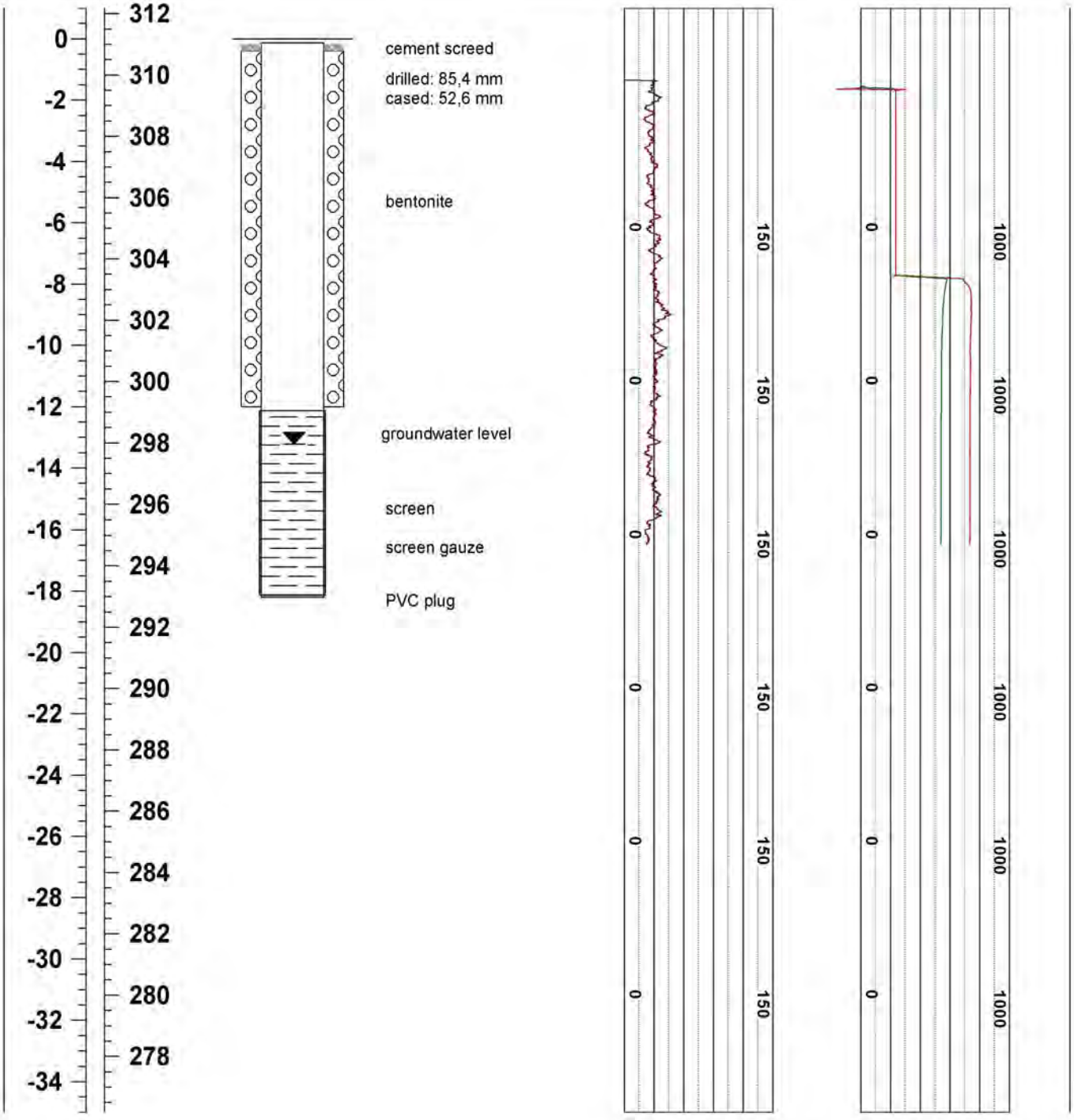
Object: **INC-8s**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **12**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-10S	**Observation well**	**Direct Push Method**	**20.10.2010**	**Z= 297,98**
Location: **Brest**	X=	Y=	Field altitude: Z= **311,18**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

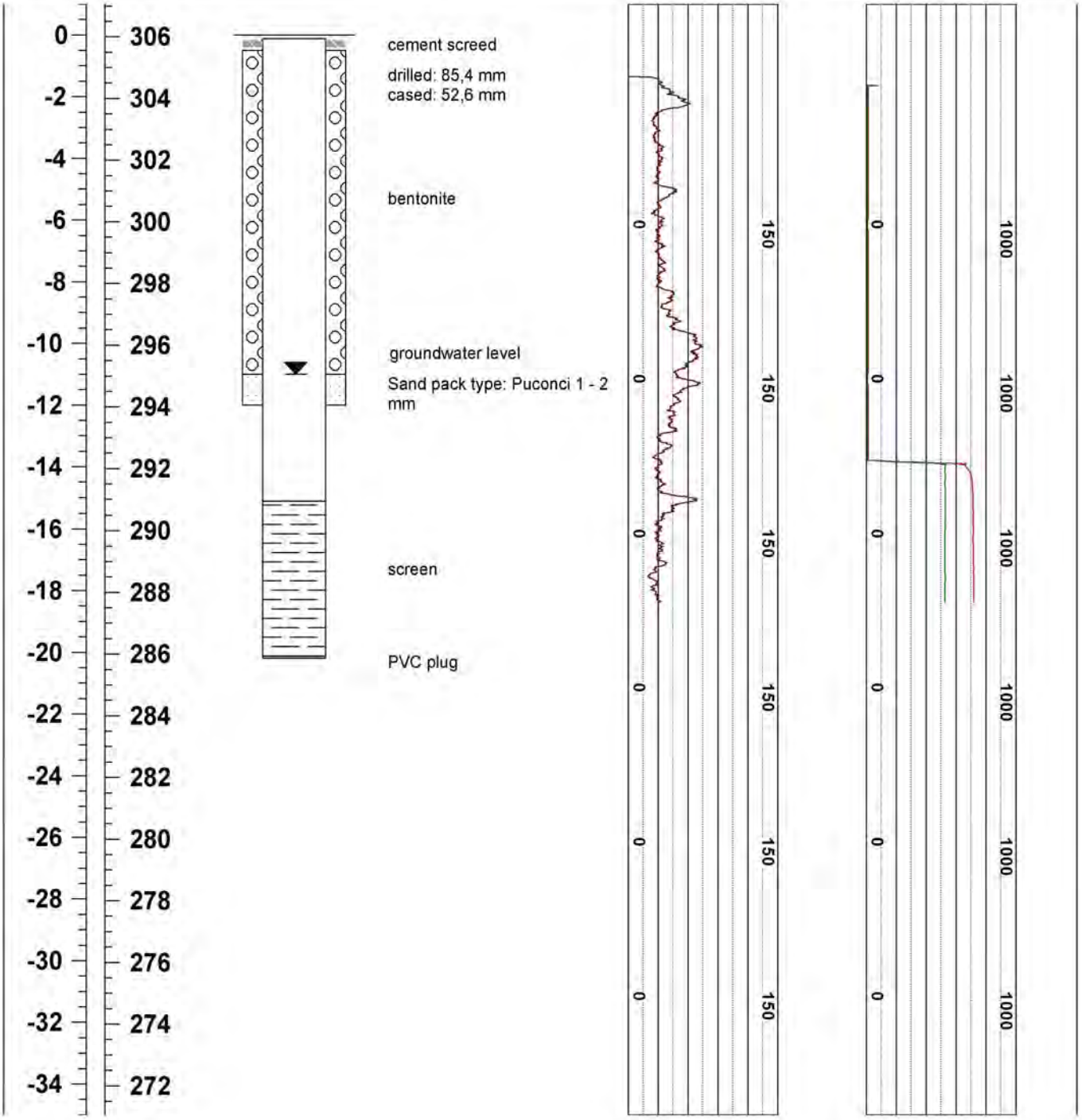


Object: **INC-10S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **13**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-11S	**Observation well**	**Direct Push Method**	**21.10.2010**	**Z= 294,86**
Location: **Brest**	X=	Y=	Field altitude: **Z= 306,059**	Top of Casing altitude: Z=

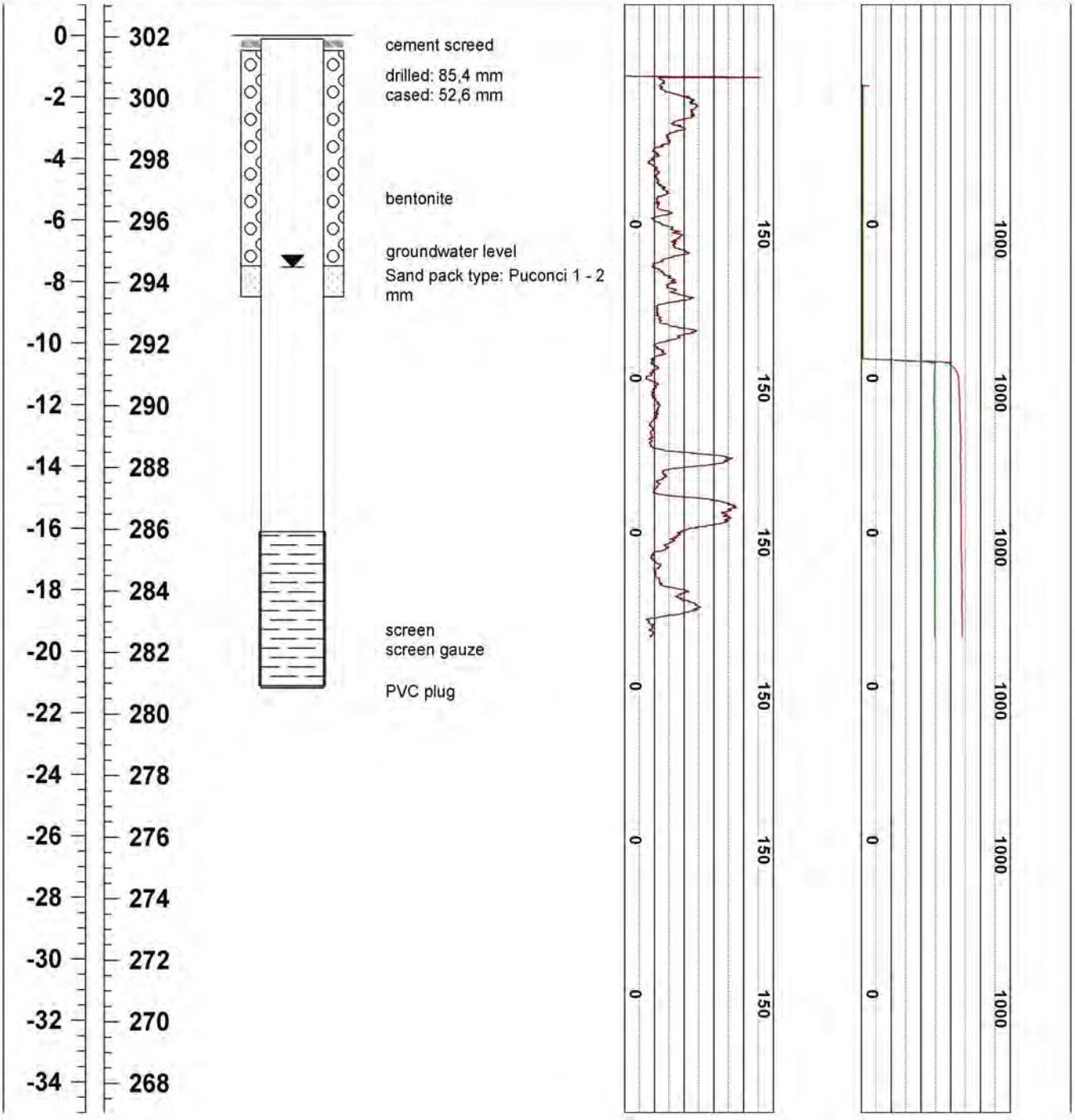
Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)



Object: **INC-11S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **14**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-12S	**Observation well**	**Direct Push Method**	**22.10.2010**	**Z= 294,45**
Location: **Brest**	X=	Y=	Field altitude: **Z= 302,048**	Top of Casing altitude: Z=

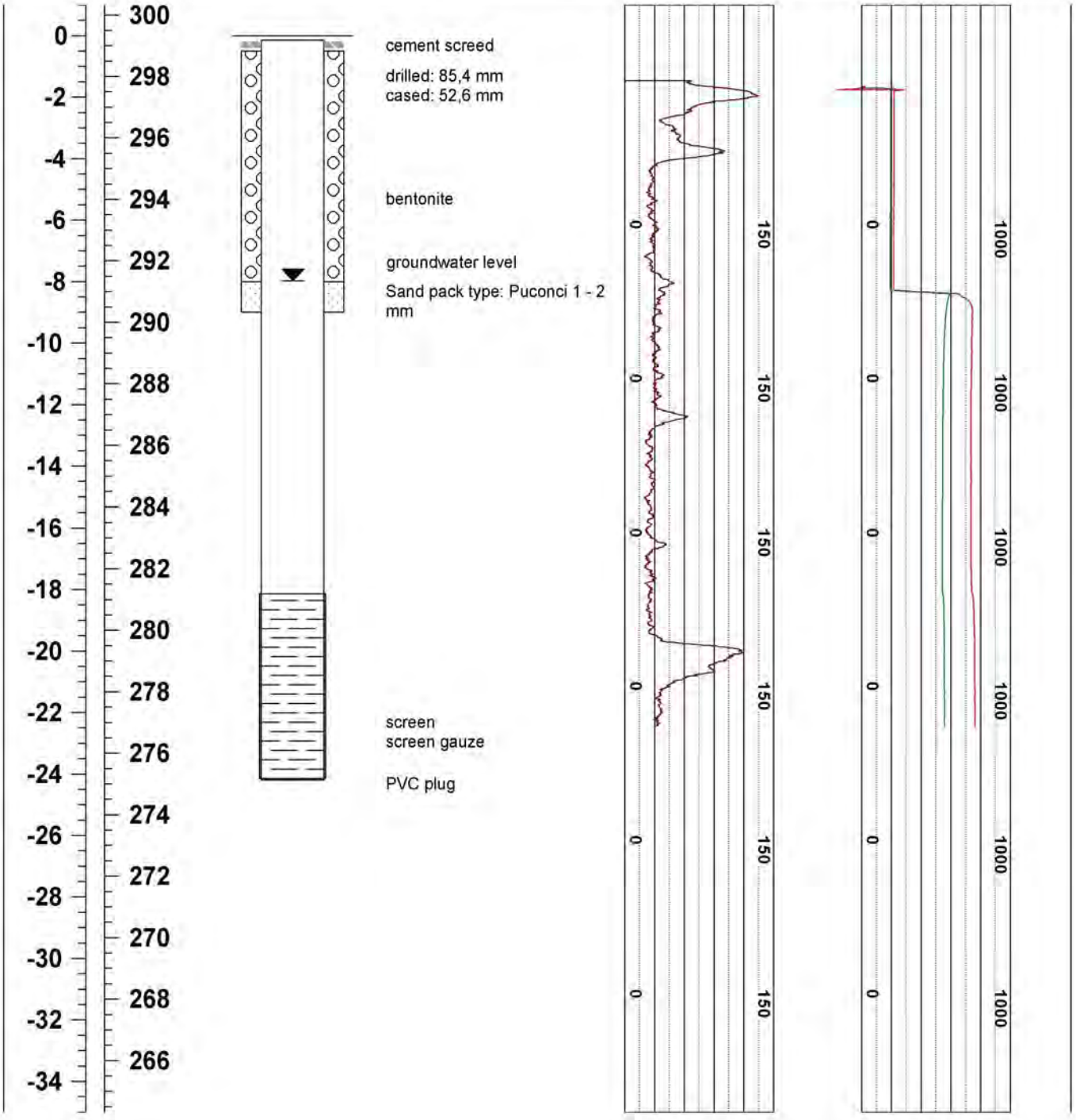


Object: **INC-12S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **15**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-13D	**Observation well**	**Direct Push Method**	**23.10.2010**	**Z= 291.33**
Location: **Brest**	X=	Y=	Field altitude: Z= **299,324**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

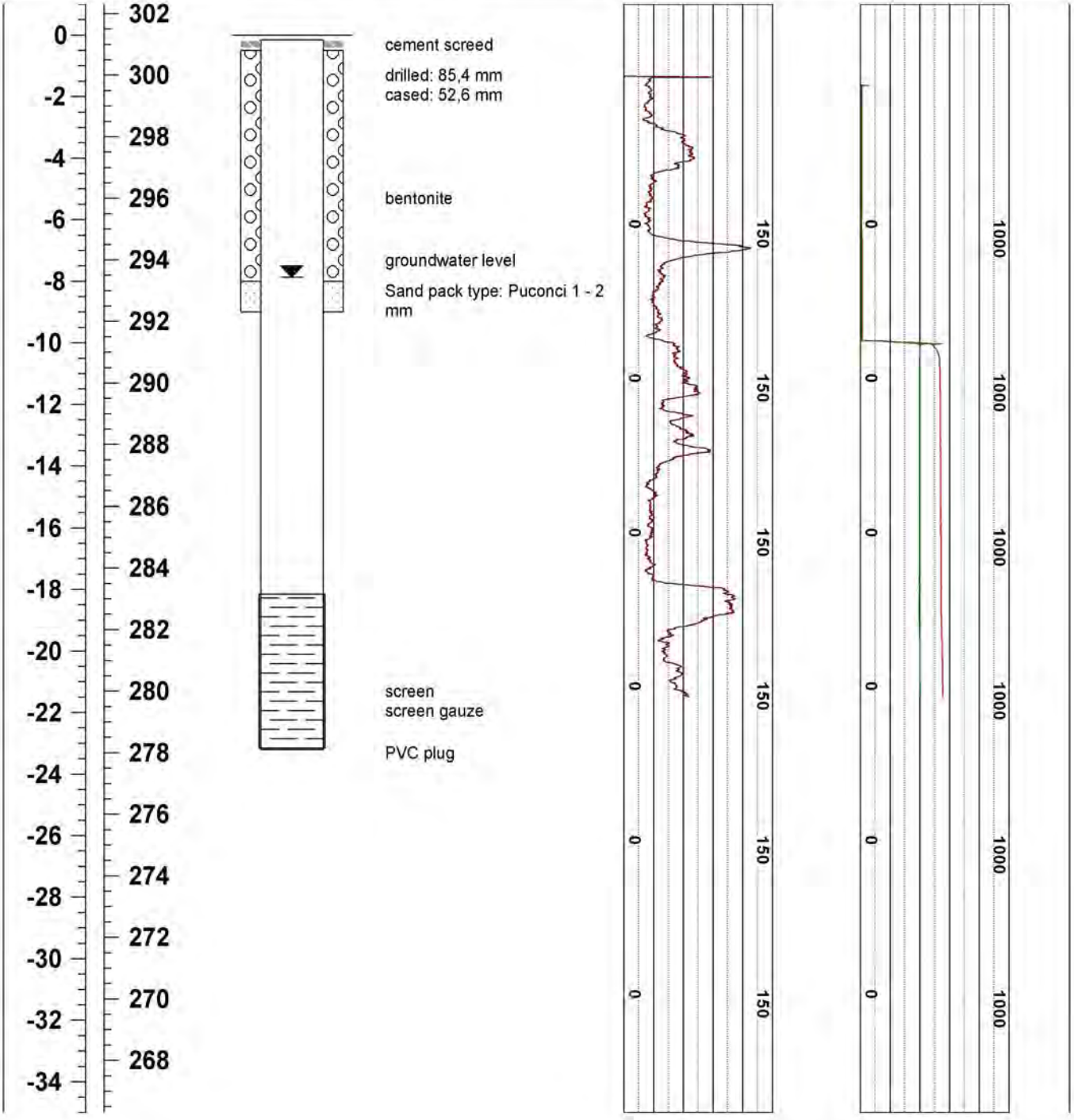


Object: **INC-13D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **16**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-14D	**Observation well**	**Direct Push Method**	**23.10.2010**	**Z= 293,37**
Location: **Brest**	X=	Y=	Field altitude: Z= **301,305**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

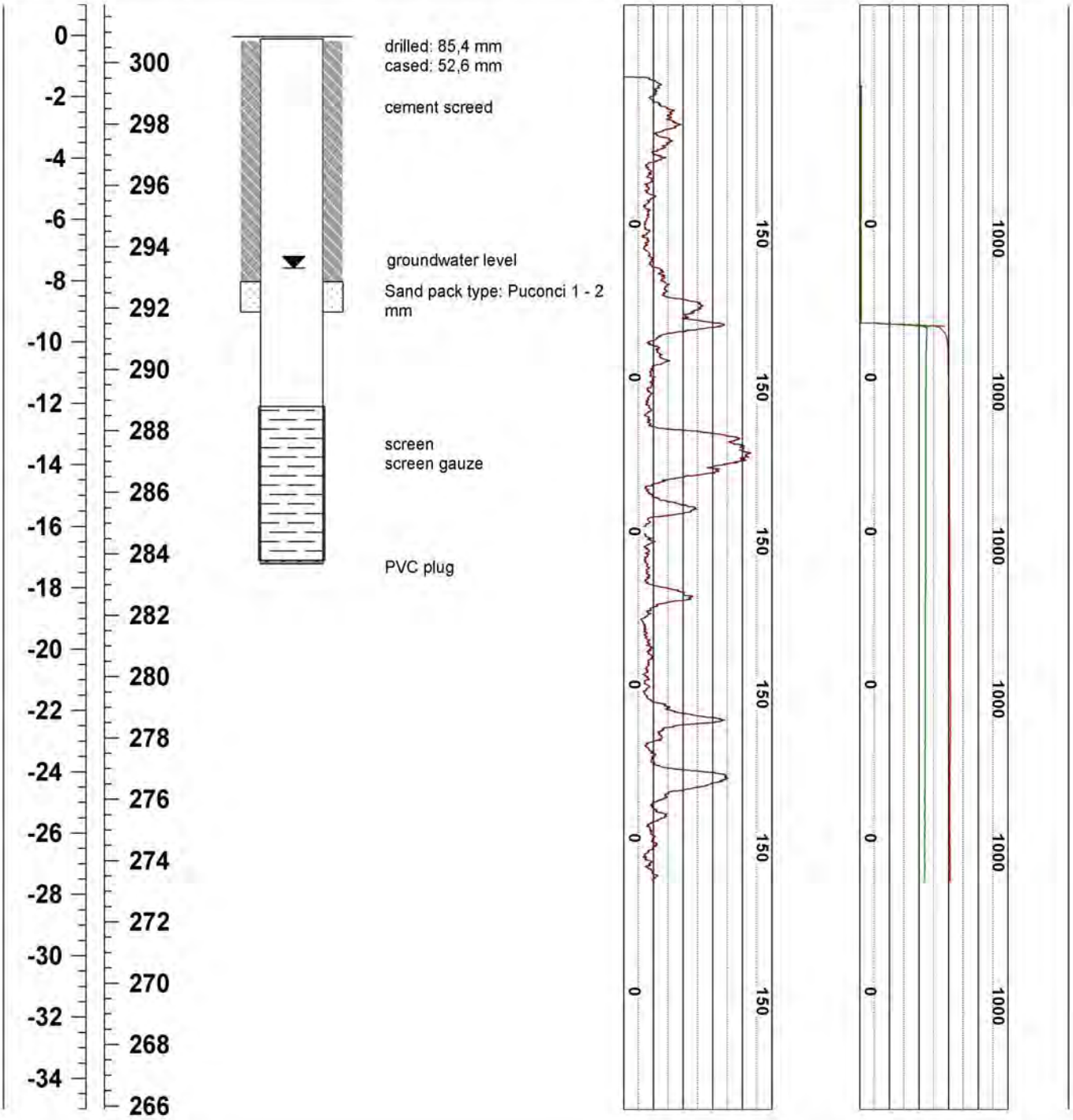


Object: **INC-14D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **17**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-15S	**Observation well**	**Direct Push Method**	**28.10.2010**	**Z= 293,17**
Location: **Brest**	X=	Y=	Field altitude: Z= **300,891**	Top of Casing altitude: Z=

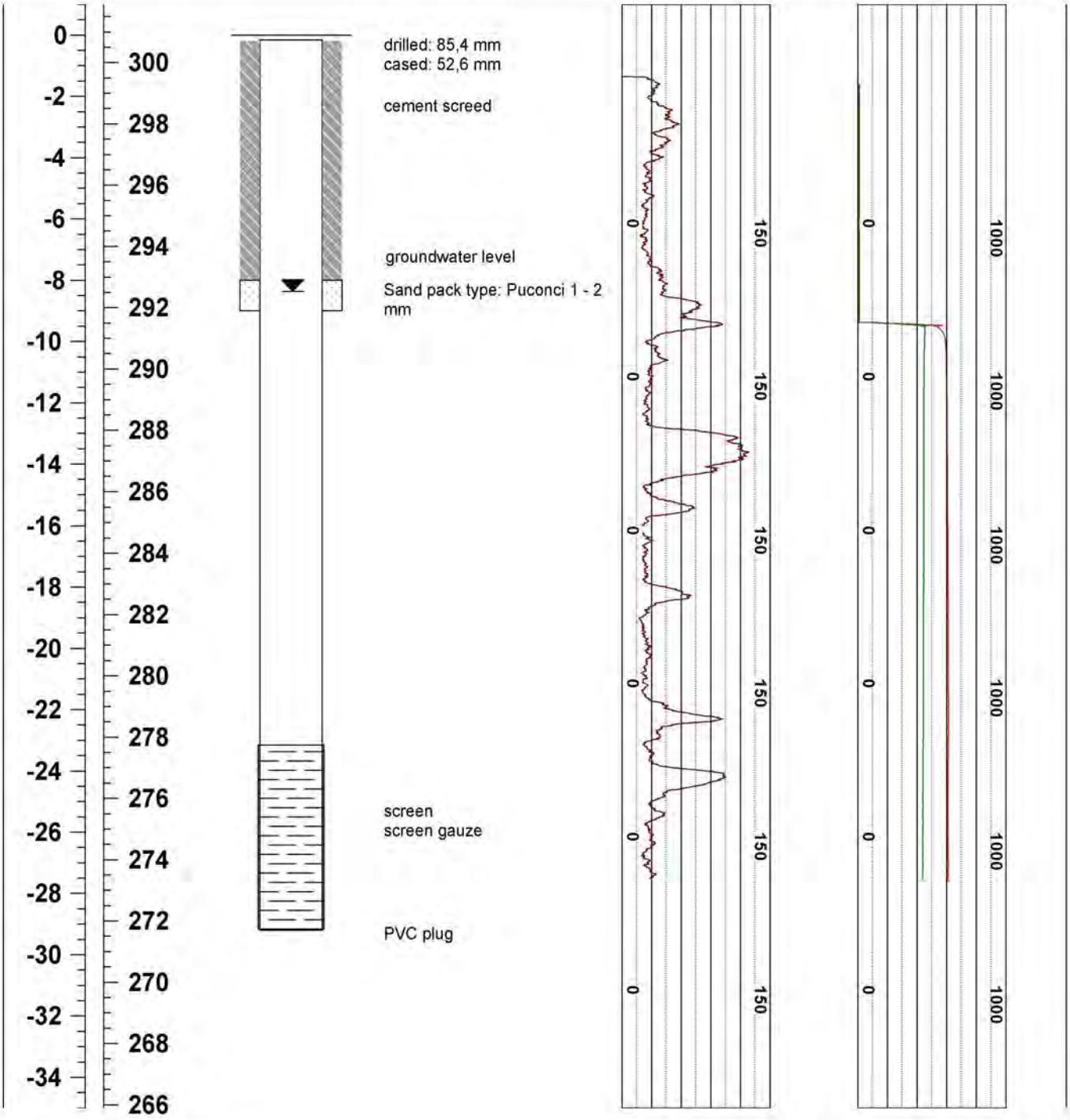
Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)



Object: **INC-15S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **18**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-15D	**Observation well**	**Direct Push Method**	**28.10.2010**	**Z= 292,64**
Location: **Brest**	X=	Y=	Field altitude: **Z= 300,897**	Top of Casing altitude: Z=

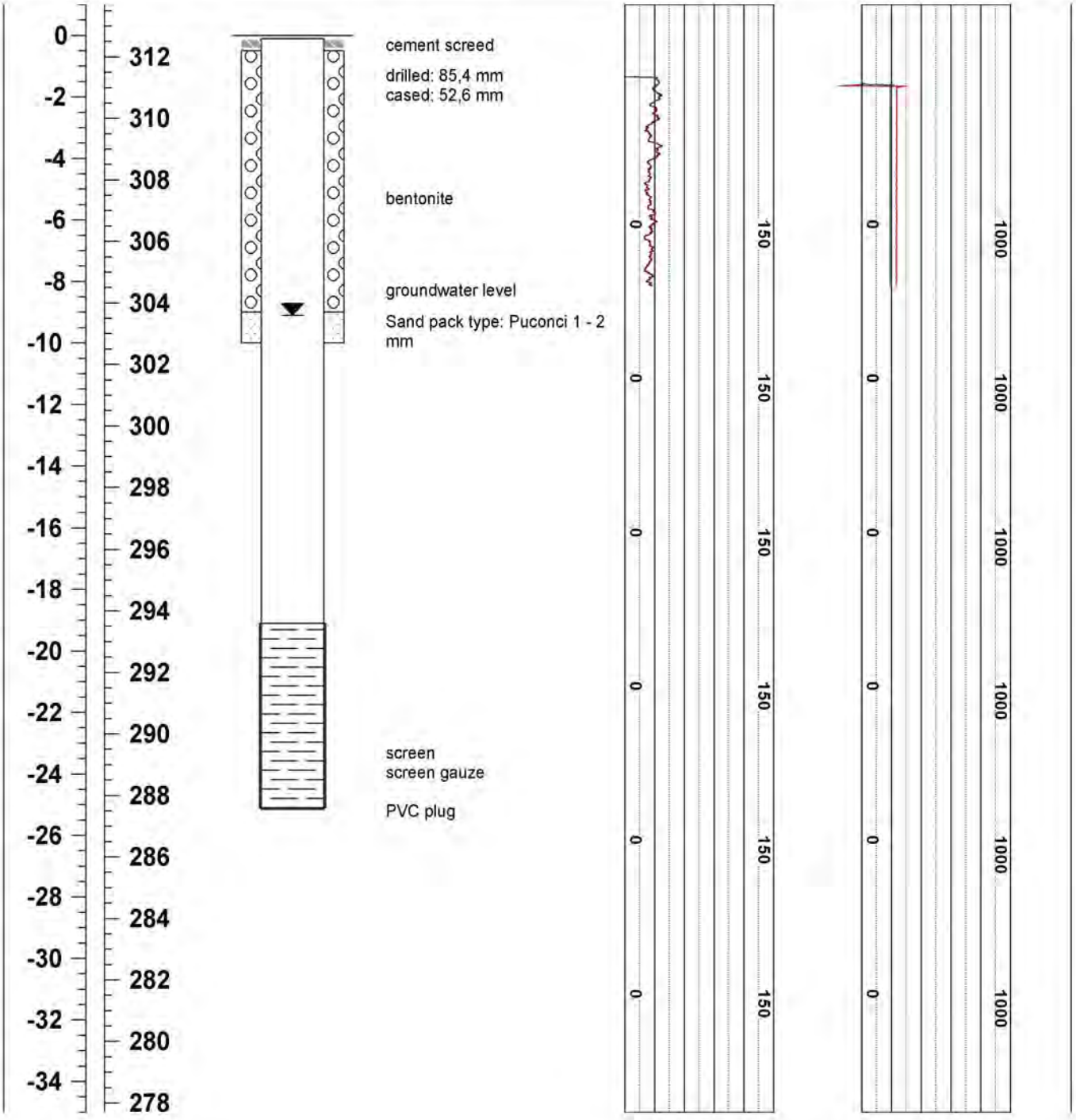


Object: **INC-15D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **19**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-16D	**Observation well**	**Direct Push Method**	**25.10.2010**	**Z= 303,44**
Location: **Brest**	X=	Y=	Field altitude: **Z= 312,699**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

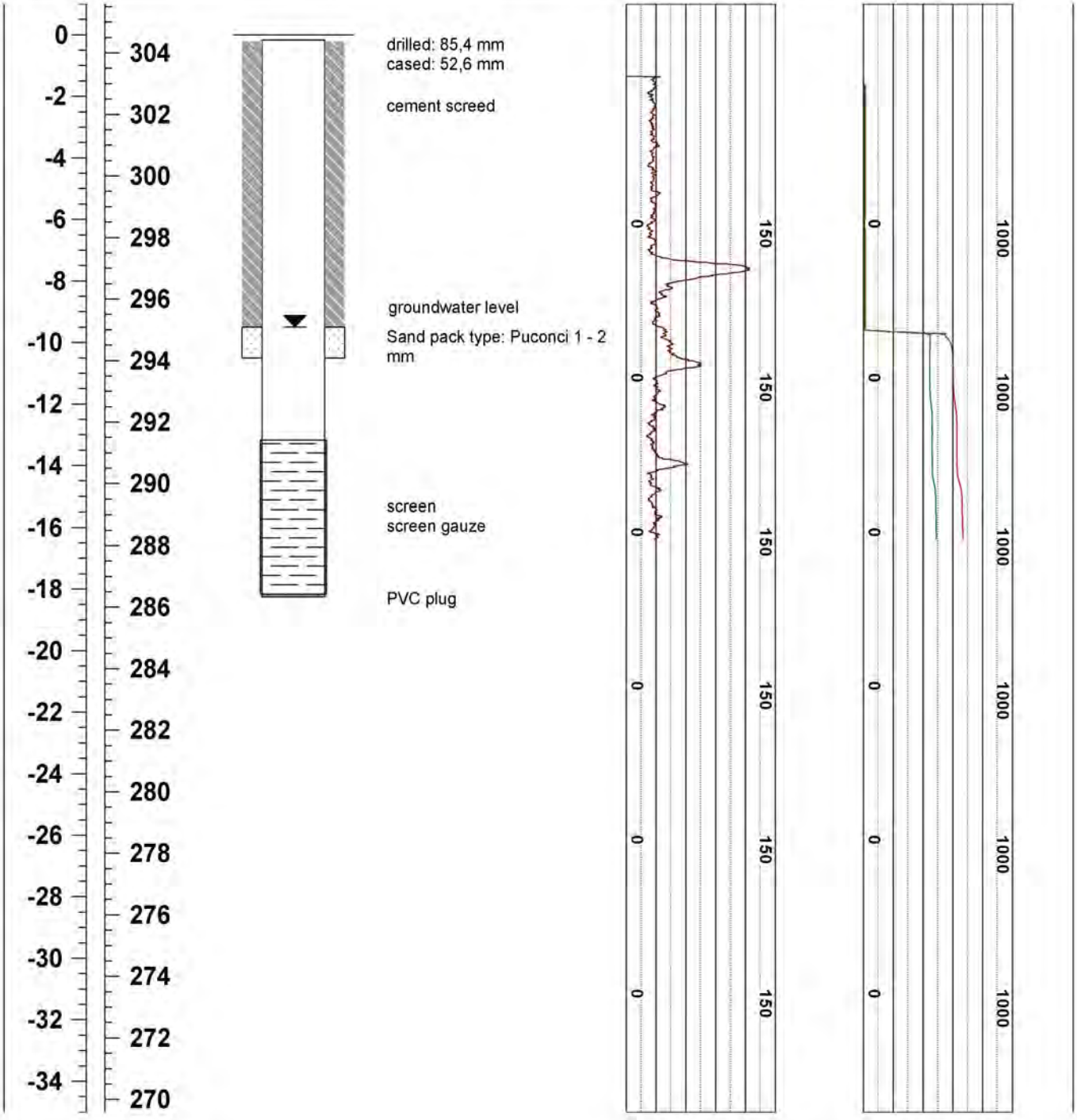


Object: **INC-16D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **20**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-17S	**Observation well**	**Direct Push Method**	**26.10.2010**	**Z= 294,90**
Location: **Brest**	X=	Y=	Field altitude: **Z= 304,589**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

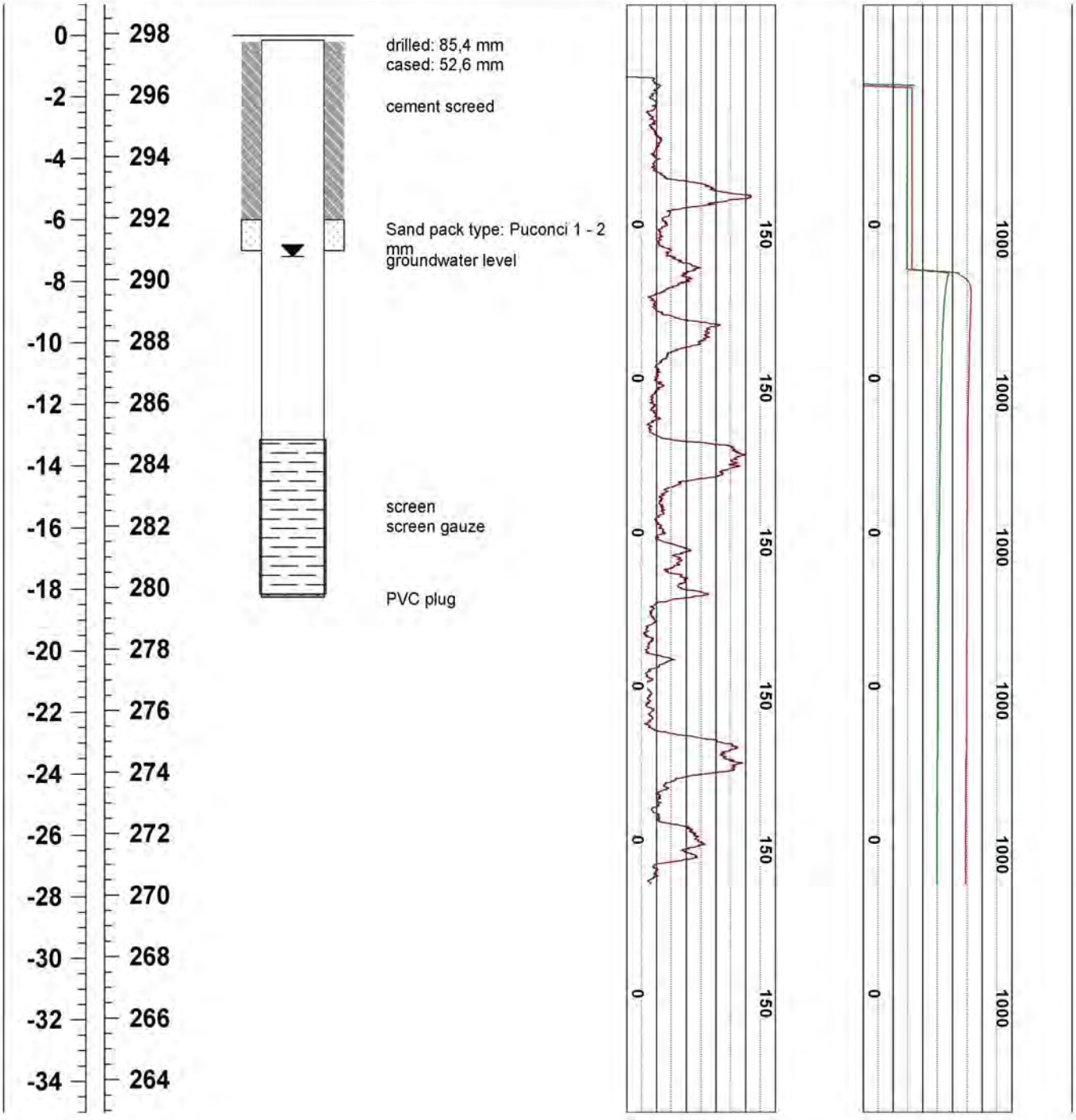


Object: **INC-17S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **21**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-18S	**Observation well**	**Direct Push Method**	**26.10.2010**	**Z= 290,6**
Location: **Brest**	X=	Y=	Field altitude: Z= **297,94**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

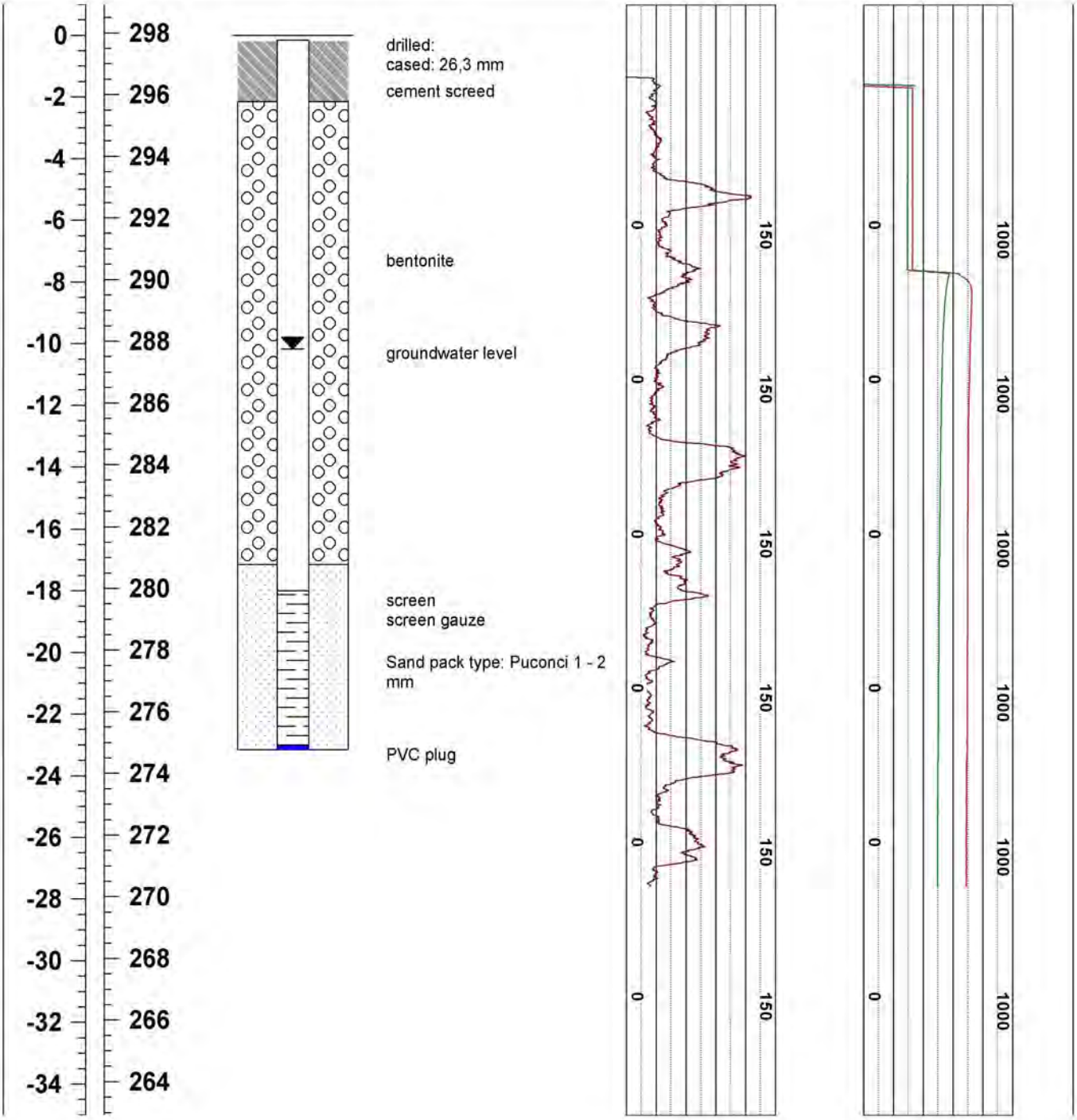


Object: **INC-18S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **22**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-18M	**Observation well**	**Direct Push Method**	**15.11.2011**	**Z= 287,593**
Location: **Brest**	X=	Y=	Field altitude: **Z= 297,923**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

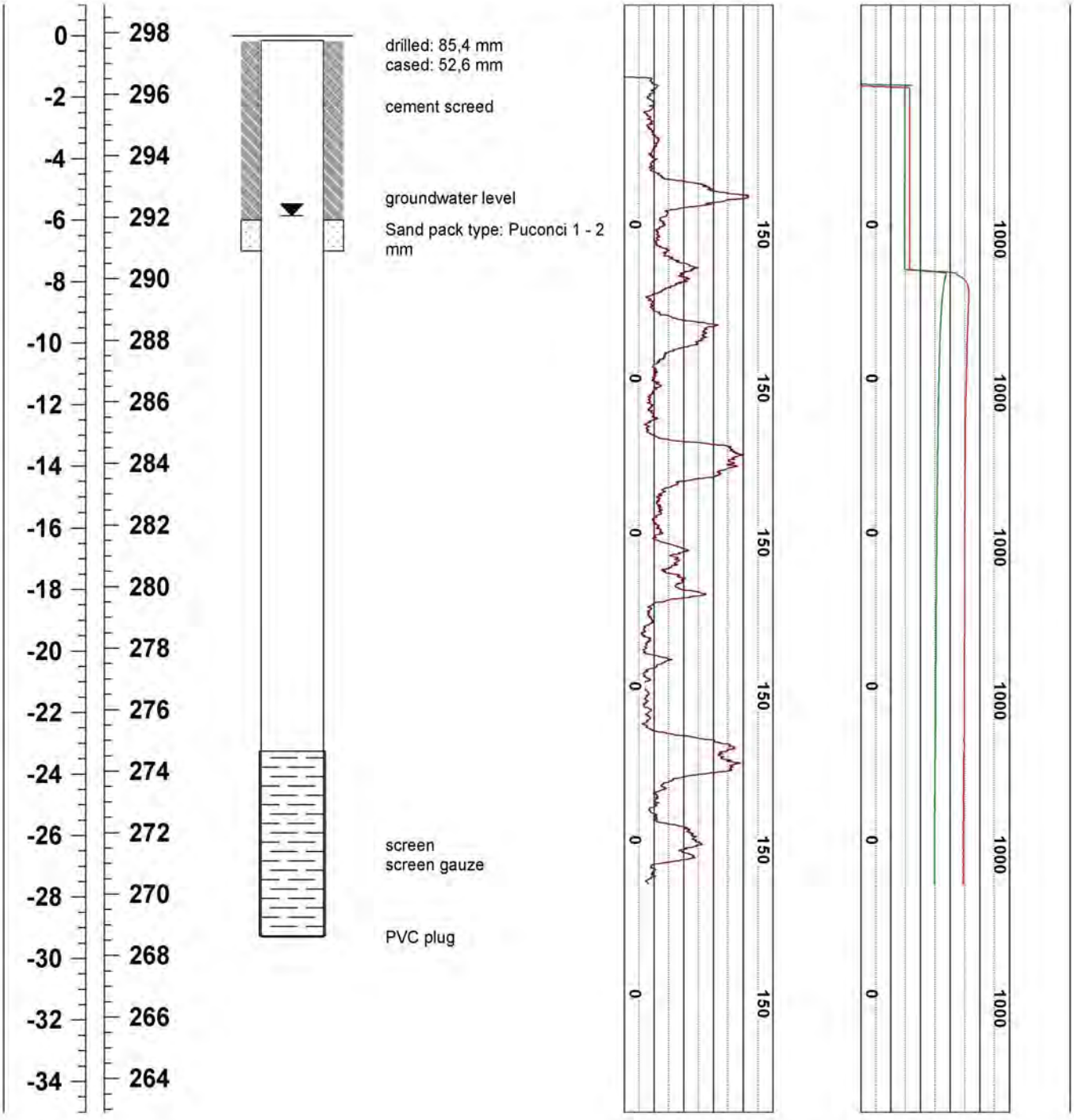


Object: **INC-18M**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **23**	**Matoz, T.**	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-18D	**Observation well**	**Direct Push Method**	**27.10.2010**	**Z= 291,97**
Location: **Brest**	X=	Y=	Field altitude: **Z= 297,905**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

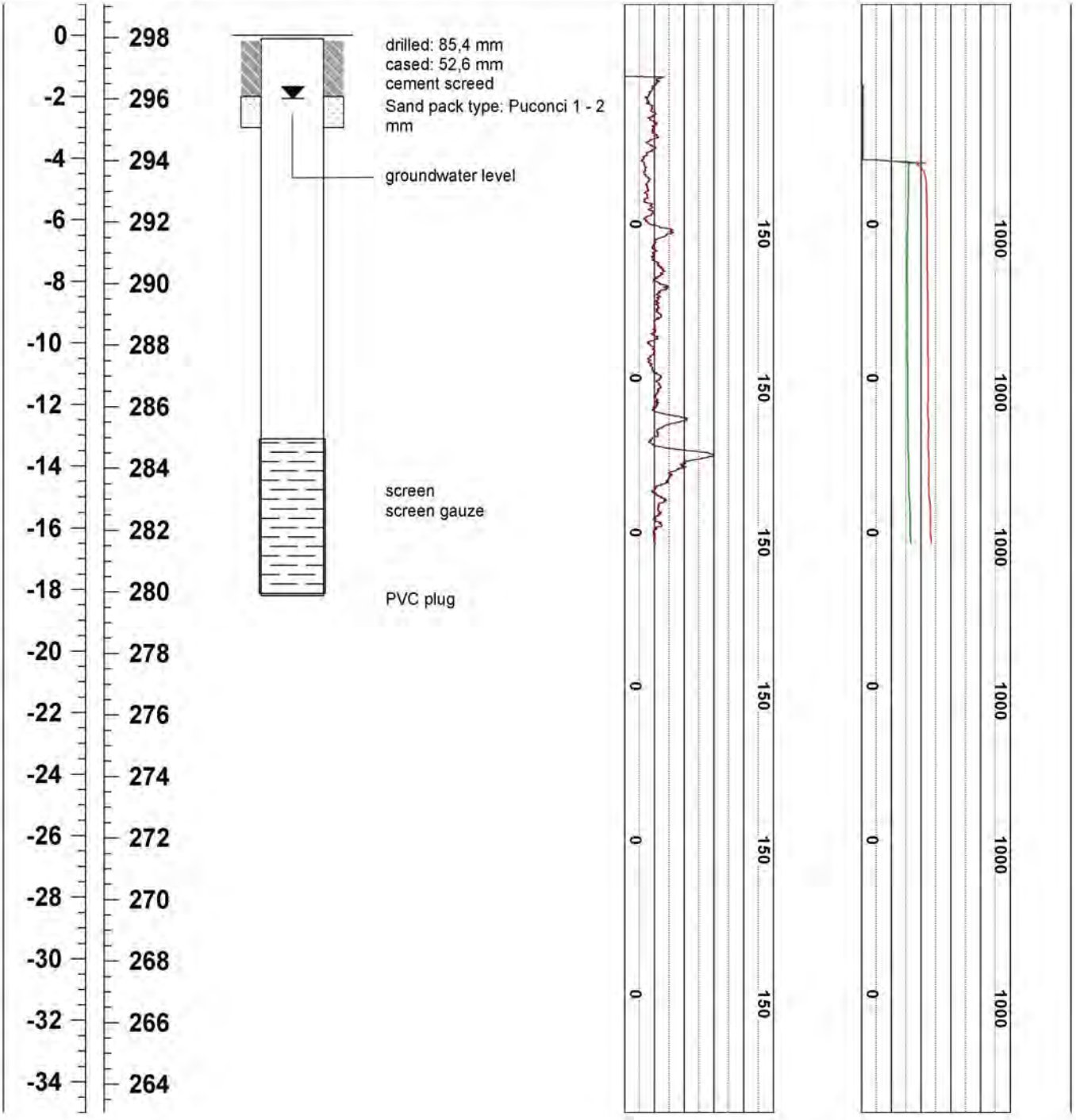


Object: **INC-18D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **24**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-19S	**Observation well**	**Direct Push Method**	**29.10.2010**	**Z= 295,81**
Location: **Brest**	X=	Y=	Field altitude: **Z= 298,079**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

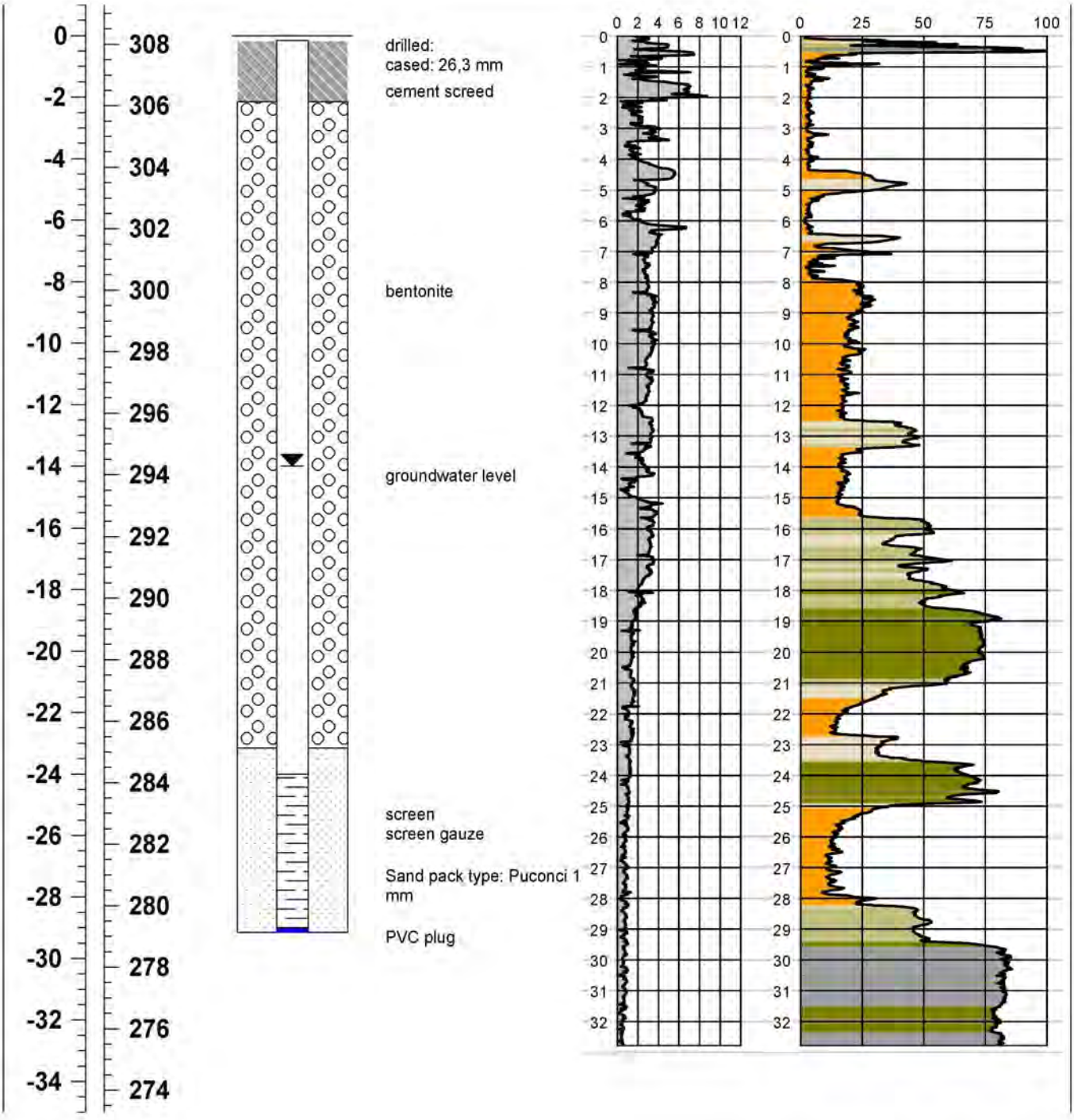


Object: **INC-19S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **25**	**Matoz, T.**	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-30D	**Observation well**	**Direct Push Method**	**24.10.2011**	**Z= 294,131**
Location: **Brest**	X=	Y=	Field altitude: **Z= 308,281**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



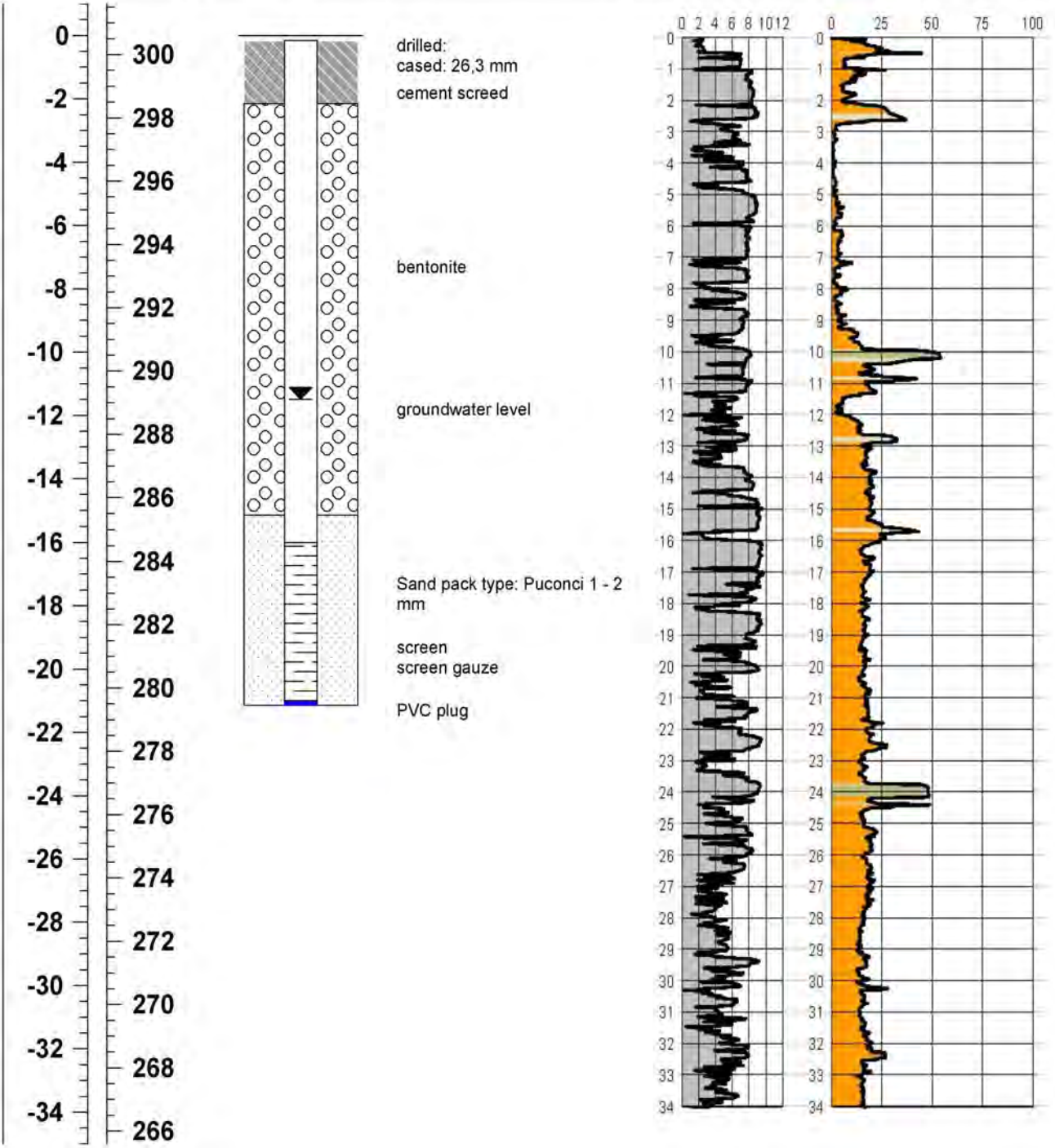
Object: **INC-30D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **26**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-31S	**Observation well**	**Direct Push Method**	**25.10.2011**	**Z= 288,681**
Location: **Brest**	X=	Y=	Field altitude: **Z= 300,601**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



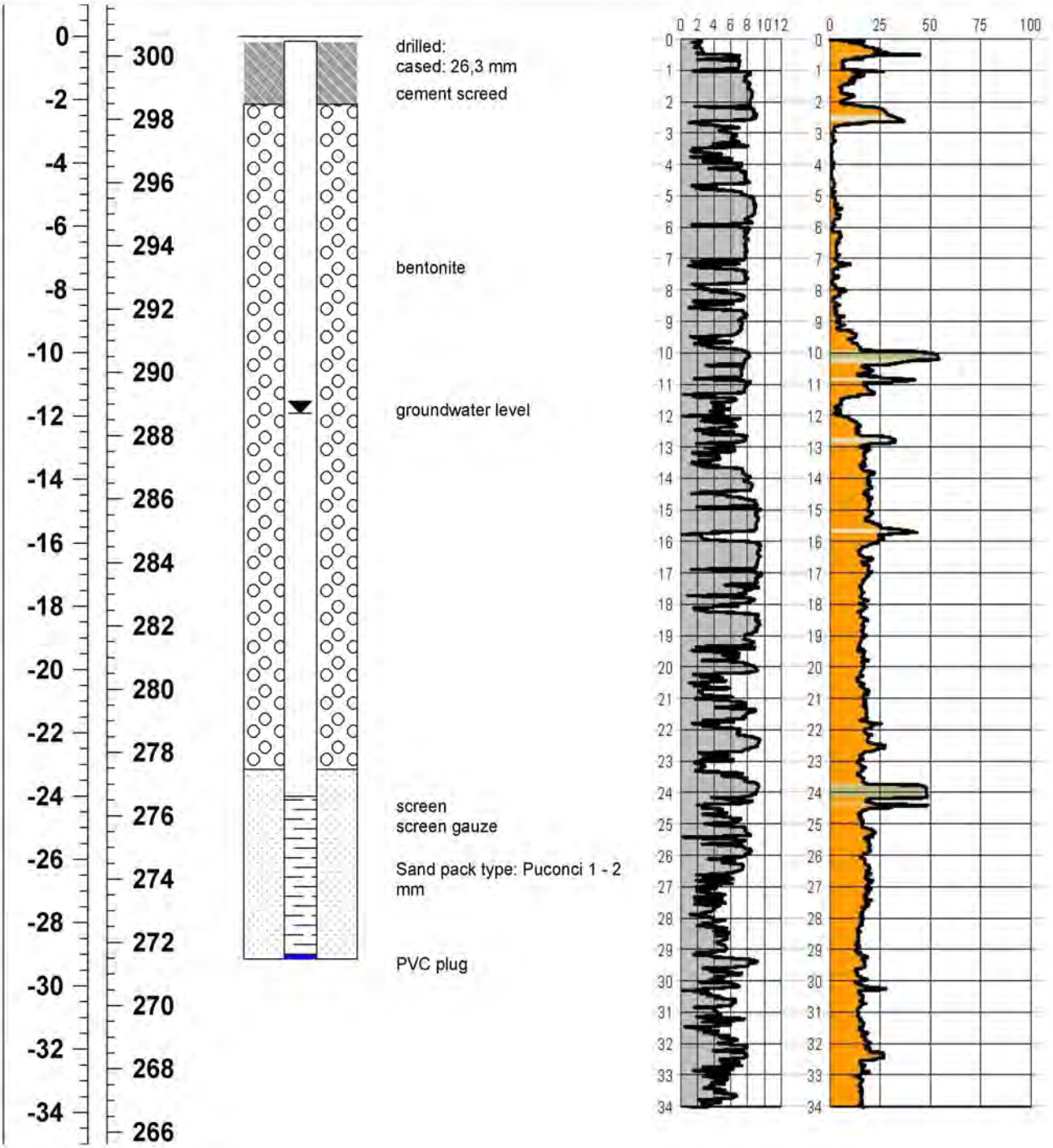
Object: **INC-31S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **27**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-31D	**Observation well**	**Direct Push Method**	**25.10.2011**	**Z= 288,563**
Location: **Brest**	X=	Y=	Field altitude: Z= **300,623**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



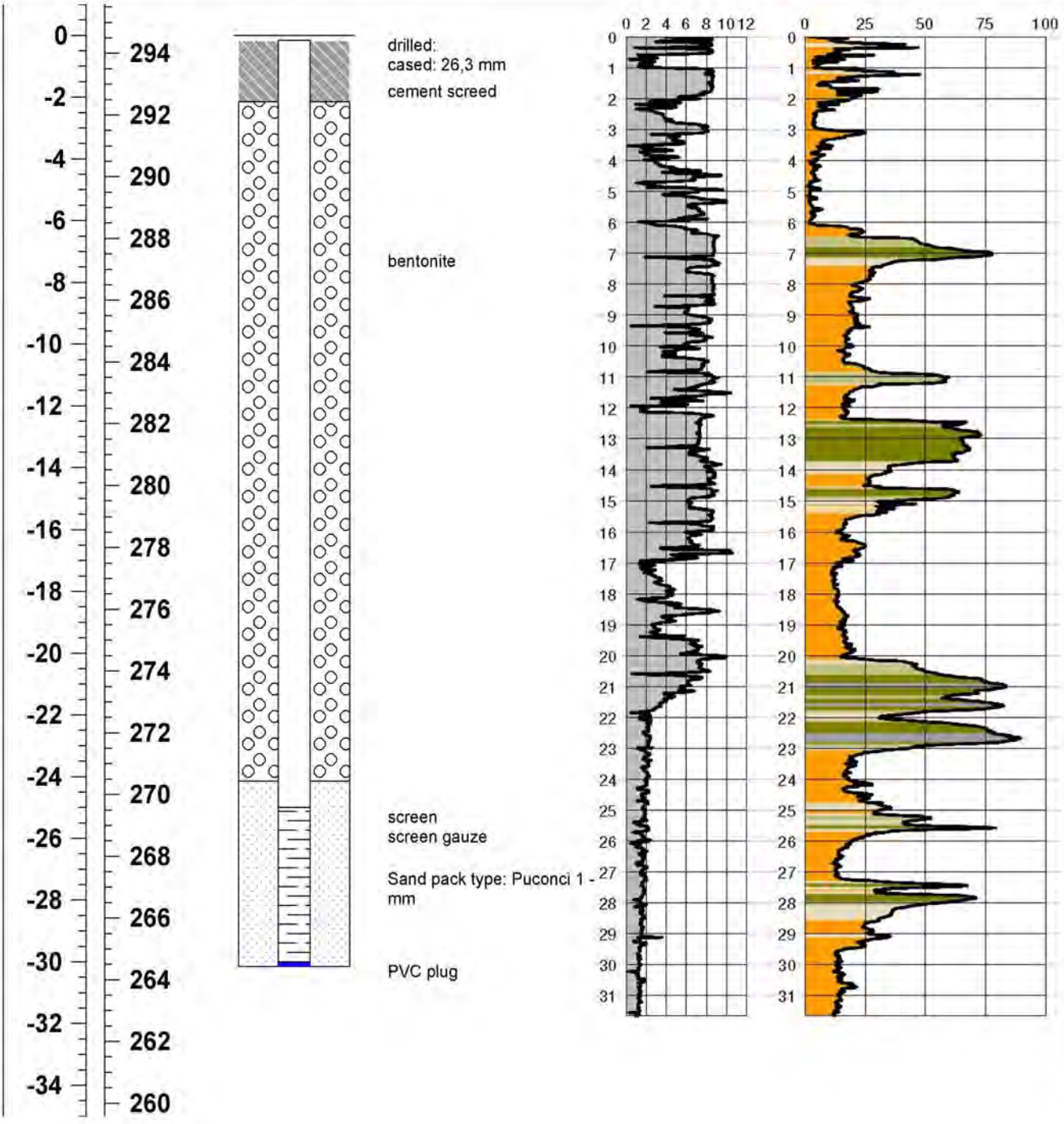
Object: **INC-31D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **28**		

Elect. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-32D	**Observation well**	**Direct Push Method**	**26.10.2011**	
Location: **Brest**	X=	Y=	Field altitude: Z= **294,580**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



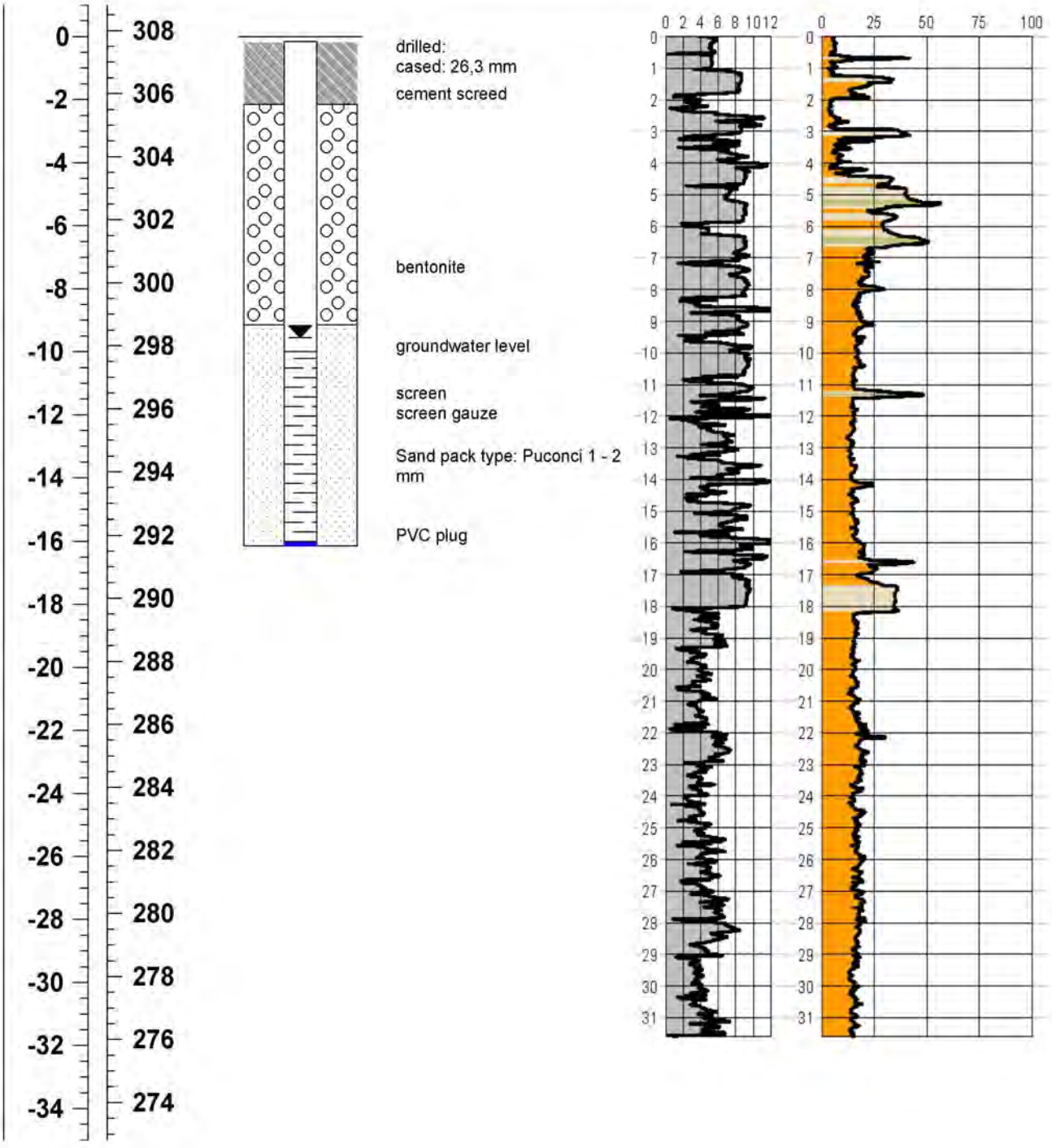
Object: **INC-32D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **29**		

Electr. Conductivity (mS/m)	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-33S	**Observation well**	**Direct Push Method**	**27.10.2011**	**Z= 298,099**
Location: **Brest**	X=	Y=	Field altitude: **Z= 307,809**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



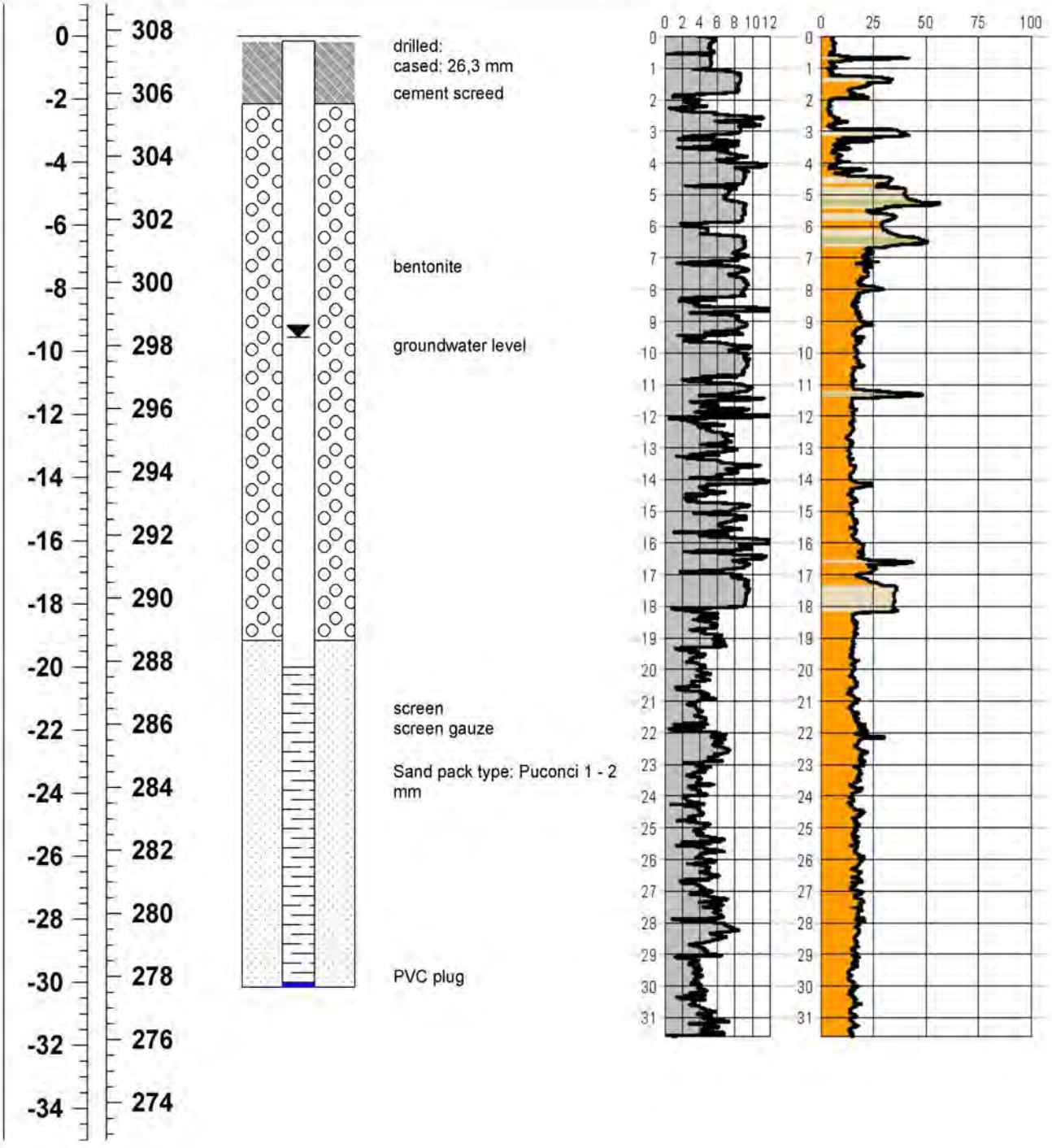
Object: **INC-33S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **30**		

Electr. Conductivity (mS/m)	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

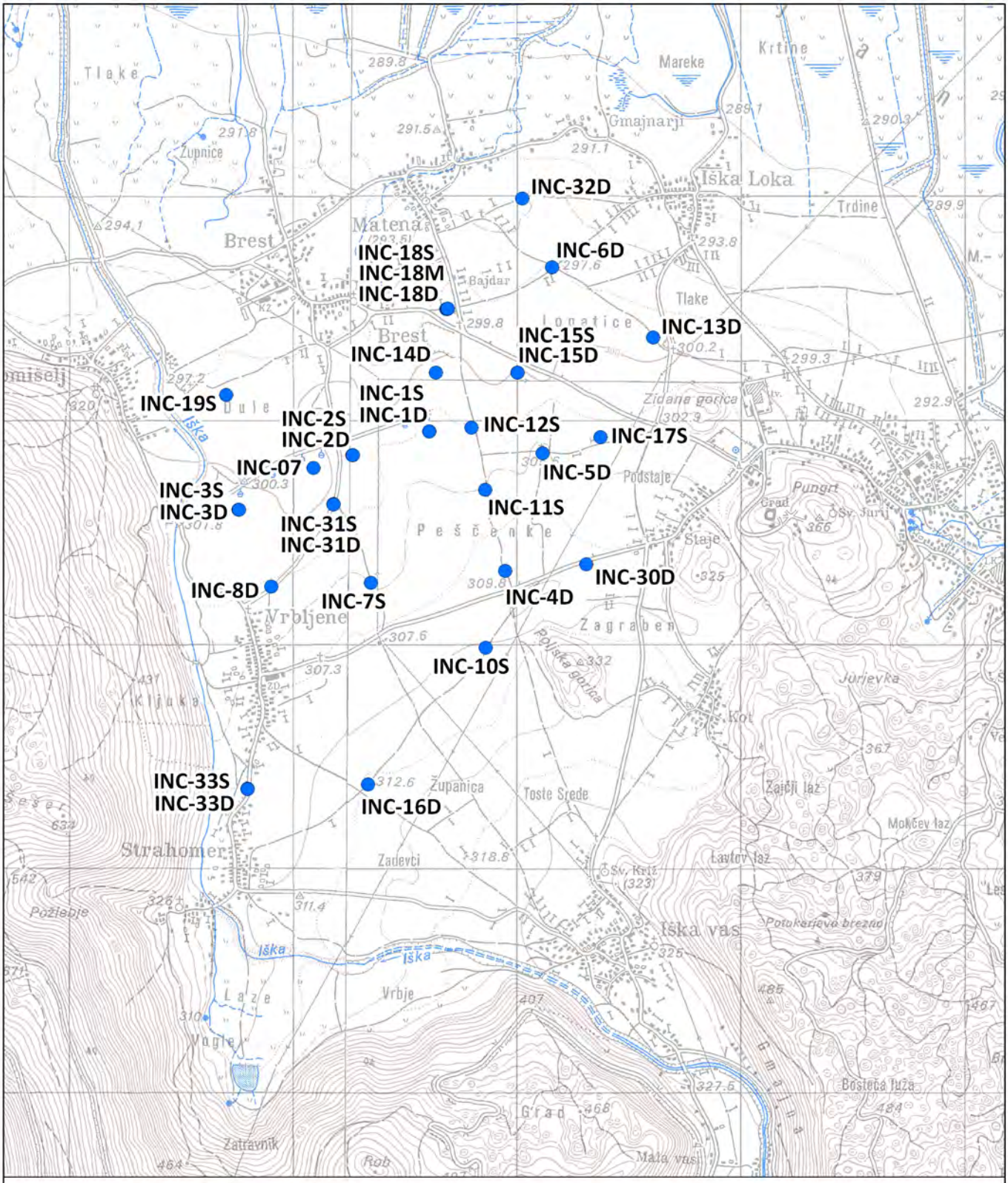
Name:	Well type:	Drill method:	Date:	GWLD:
INC-33D	**Observation well**	**Direct Push Method**	**27.10.2011**	**Z= 298,105**
Location: **Brest**	X=	Y=	Field altitude: **Z= 307,815**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



Object: **INC-33D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **31**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable



Legend

- Observation well

Life

INCOME Water Care

GeoZS Geological Survey of Slovenia

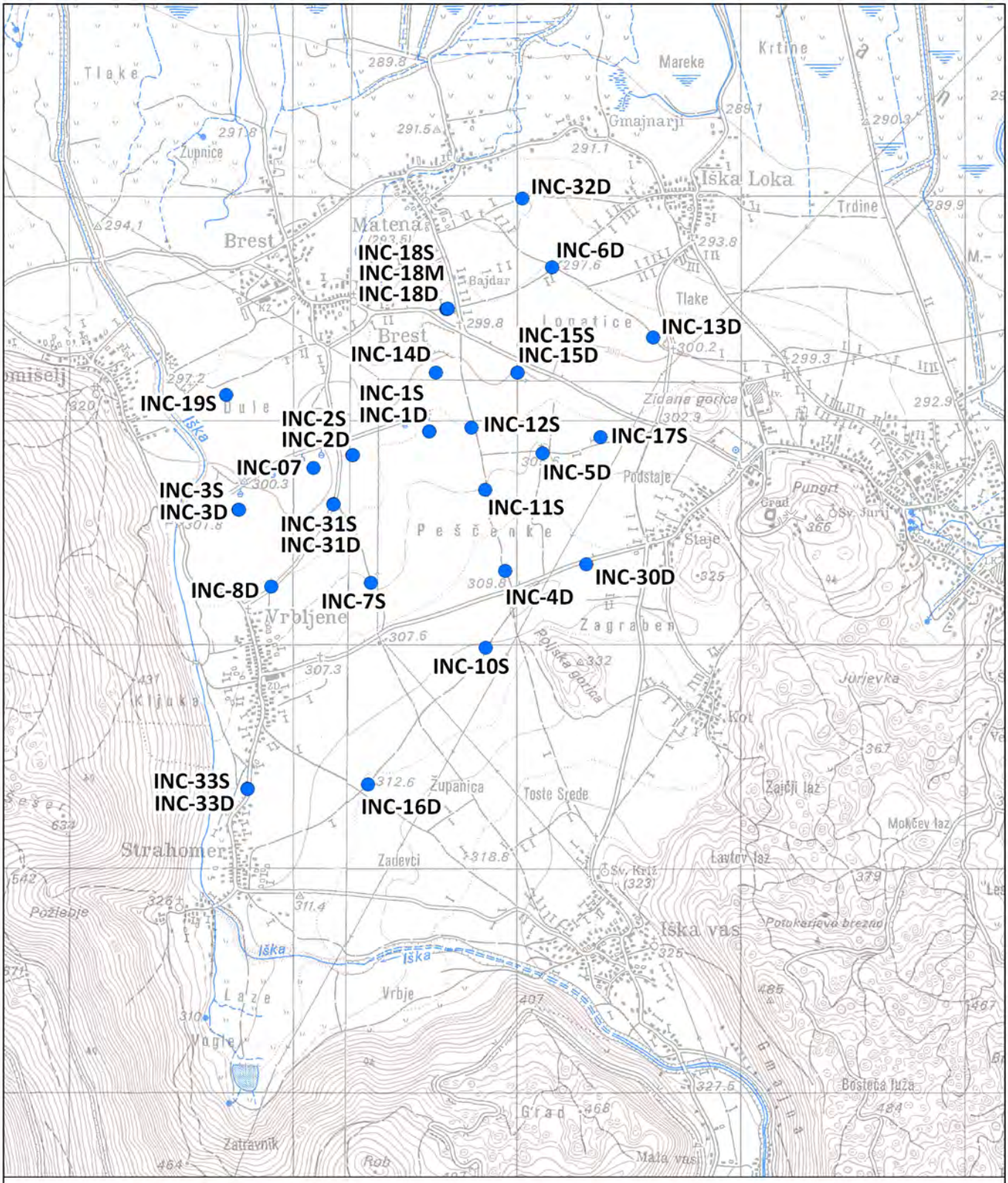
N

0 0.5 1 2km

Data source:
GURS, 1997; GeoZS, 2011.

Digital cartography:
Meglič P.

Appendix 1



Legend

- Observation well

Life

INCOME Water Care

GeoZS Geological Survey of Slovenia

N

0 0.5 1 2km

Data source:
GURS, 1997; GeoZS, 2011.

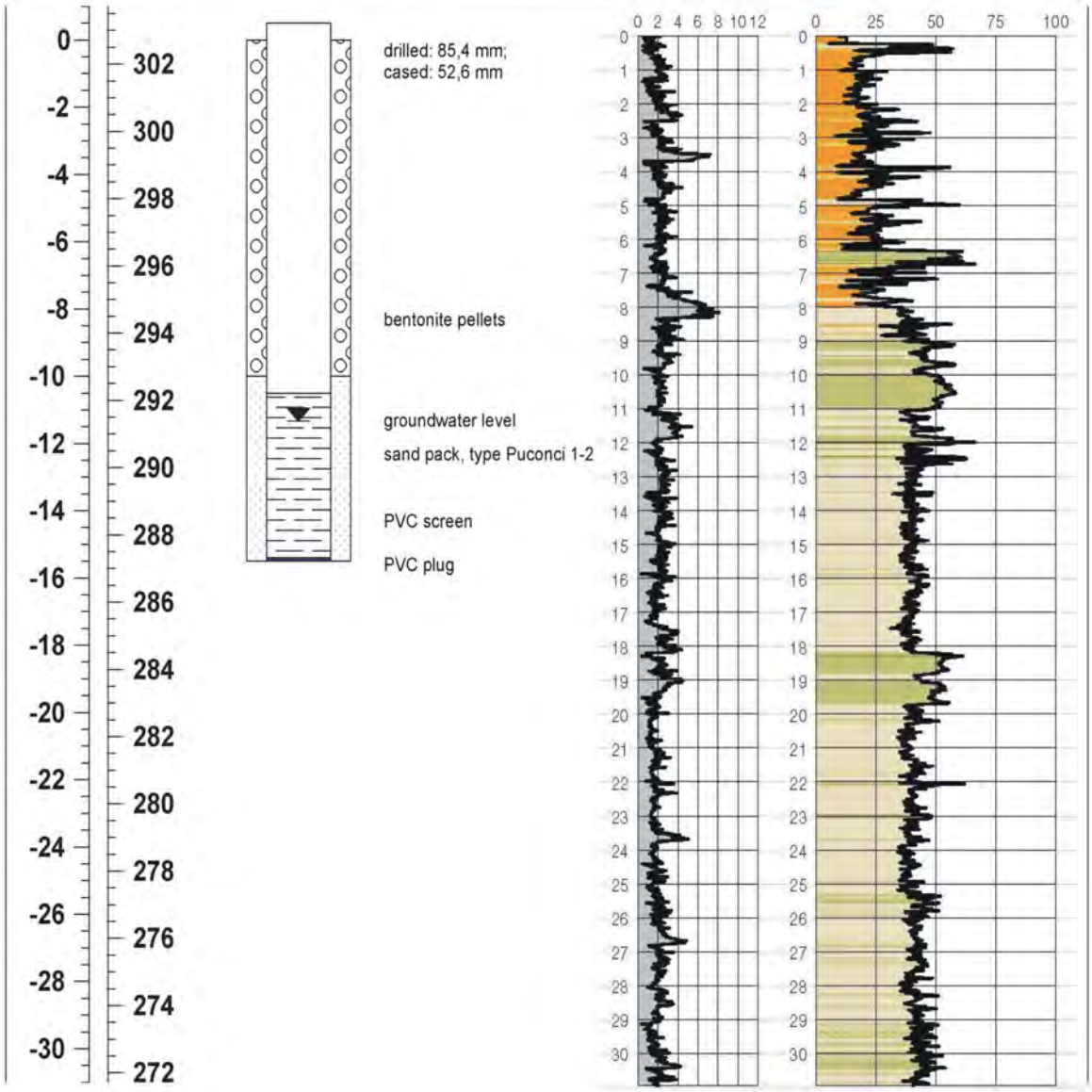
Digital cartography:
Meglič P.

Appendix 1

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-1s	**Observation well**	**Direct Push method**	**14.6.2010**	**11,3 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **302,717**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)

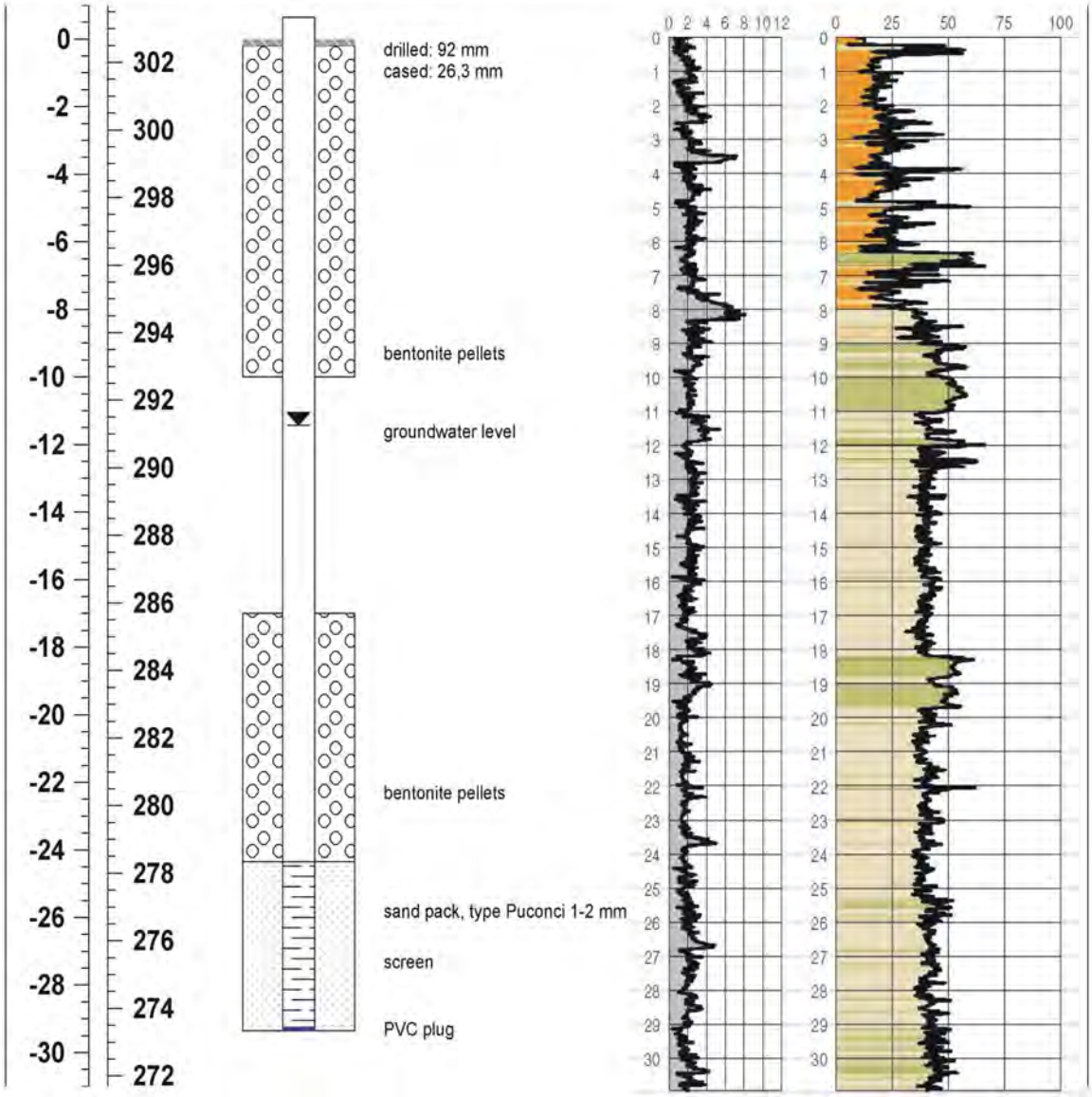


Object: **INC-1s**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **2**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-1d	**Observation well**	**Direct Push method**	**14.6.2010**	**11,43 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **302,690**	Top of Casing altitude: Z=



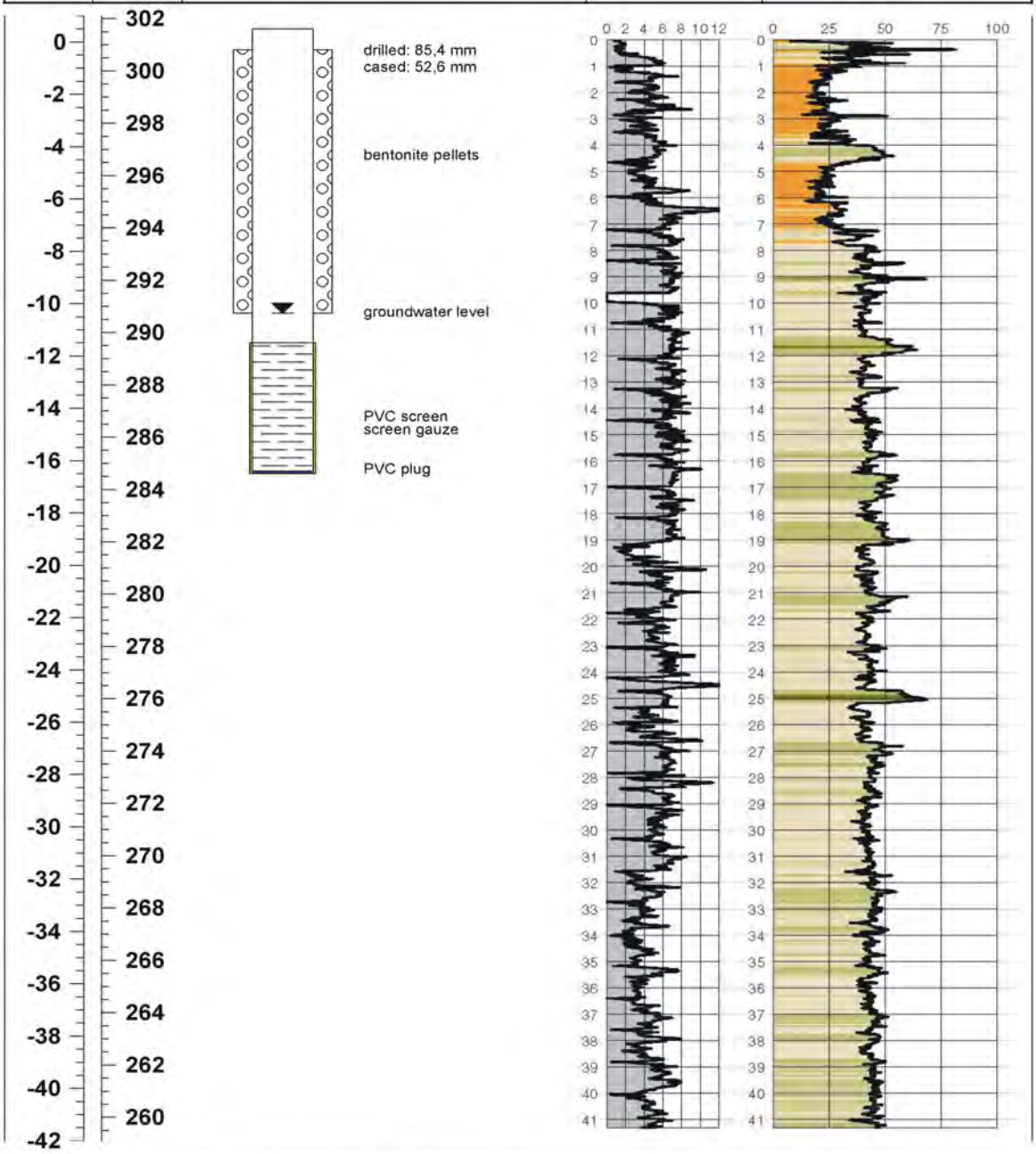
Object: **INC-1d**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **3**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-2s	**Observation well**	**Direct Push method**	**16.6.2010**	**10,37 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **301,104**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)



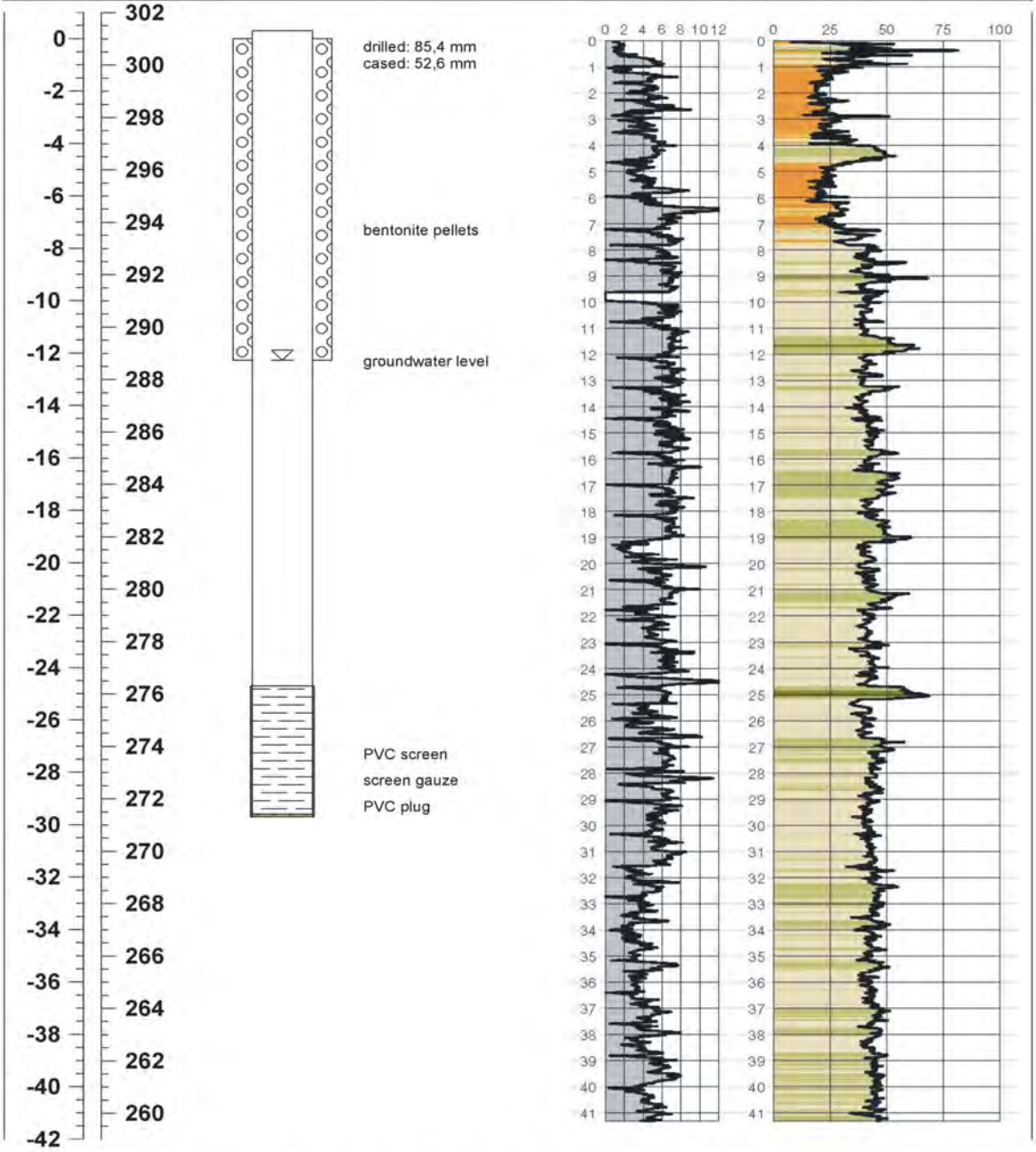
Object: **INC-2s**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical): **1:200**	Processed: **Meglič P., Šram D.**	
Appendix: **4**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-2d	**Observation well**	**Direct Push method**	**16.6.2010**	**12,27 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **301,012**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)

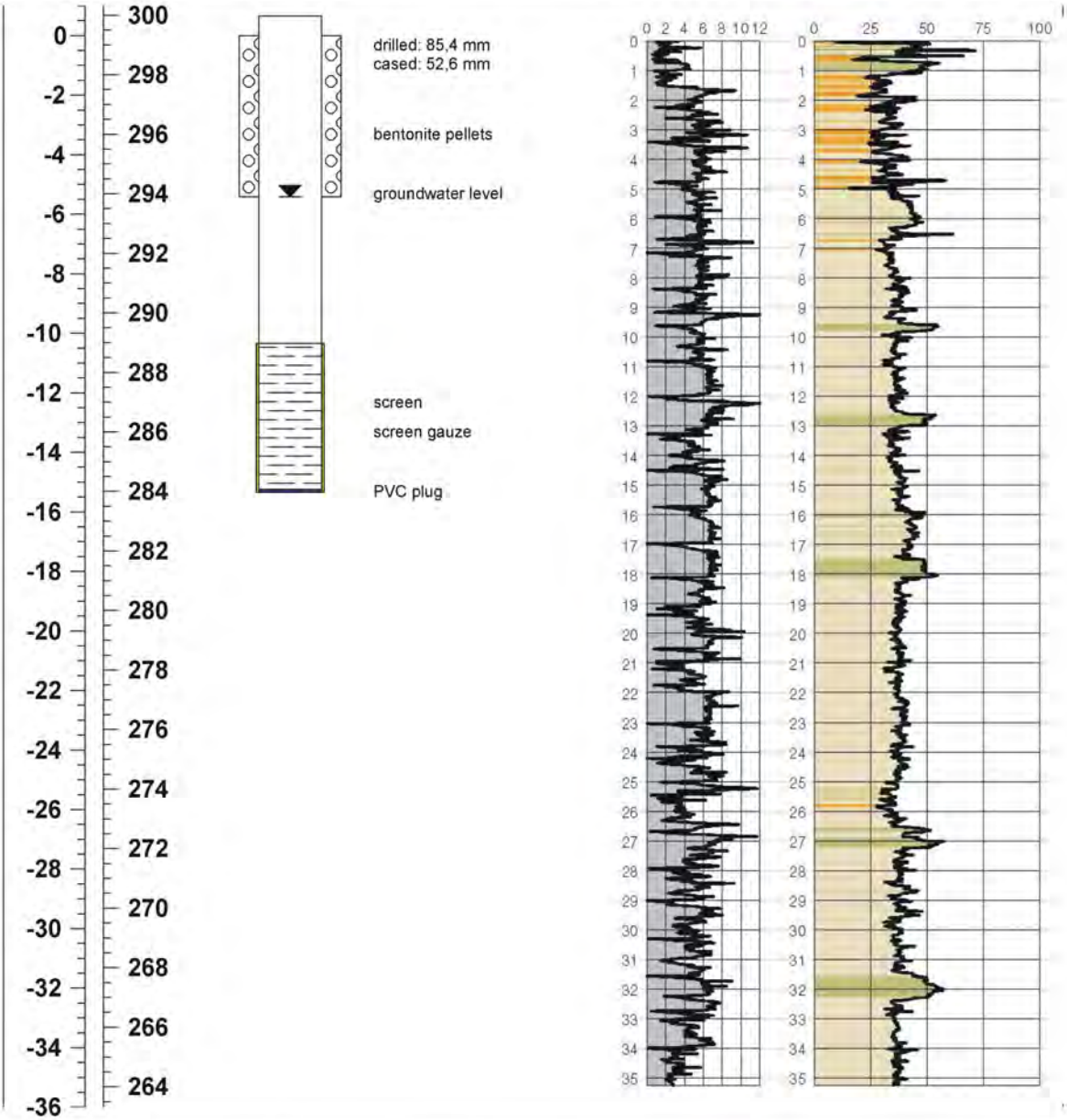


Object: **INC-2d**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	Electr. Conductivity [mS/m] — Interpretation
Scale (vertical):	Processed: **Meglič P., Šram D.**	0 - 30 GRAVEL - SAND 30 - 45 SAND, silty 45 - 60 SAND, very silty 60 - 80 SILT 80 - 200 SILT - CLAY > 200 not interpretable
Appendix: **5**		

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-3s	**Observation well**	**Direct Push method**	**16.6.2010**	**5,41 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **299,313**	Top of Casing altitude: Z=

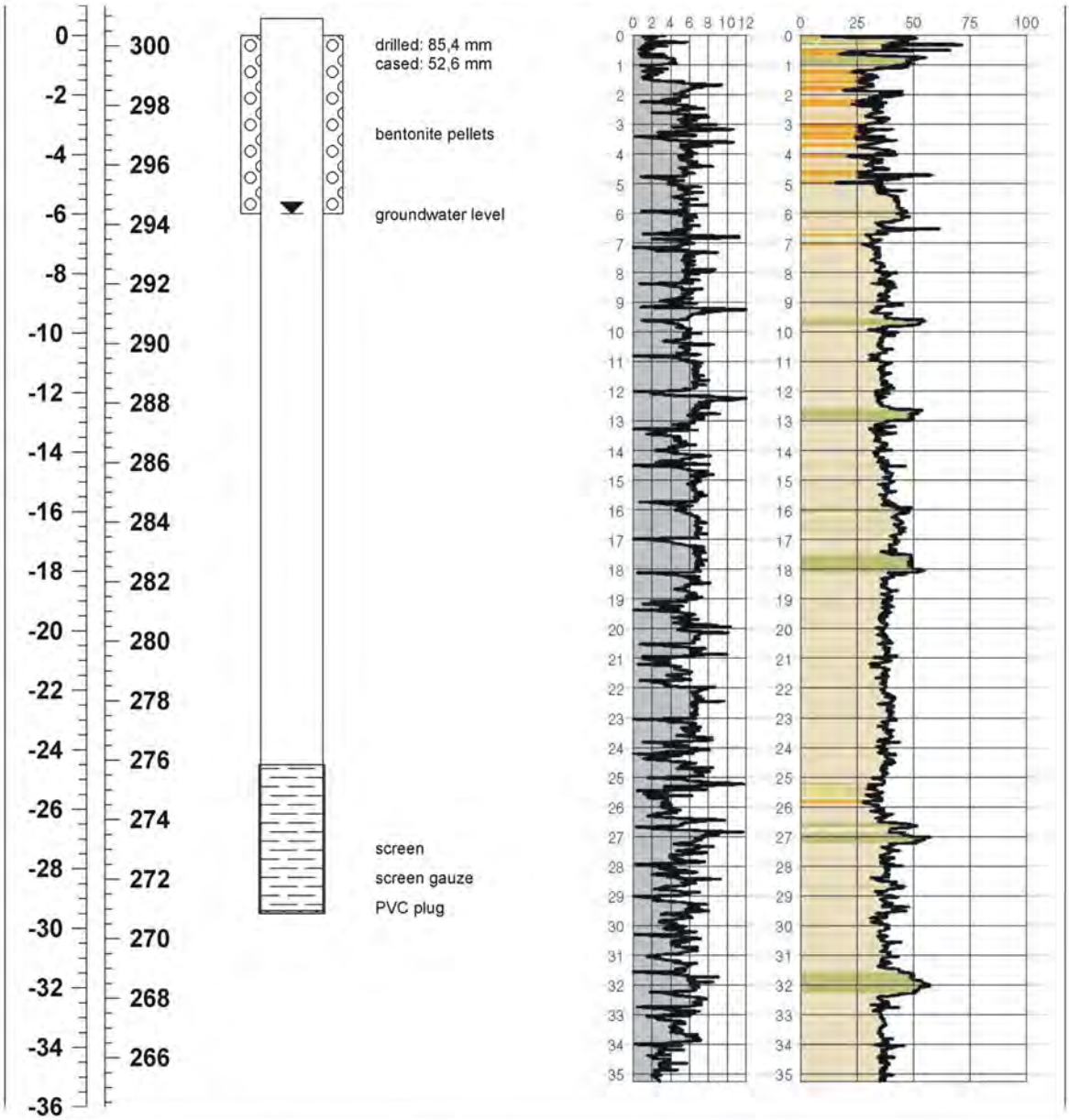
Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)



Object: **INC-3s**	Contractor:	Legende:	
Claimer:	**Geo-log, GmbH; University of Göttingen**	Electr. Conductivity [mS/m]	Interpretation
Scale (vertical):	Processed: **Meglič P., Šram D.**	0 - 30	GRAVEL - SAND
Appendix: **6**		30 - 45	SAND, silty
		45 - 60	SAND, very silty
		60 - 80	SILT
		80 - 200	SILT - CLAY
		> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-3d	**Observation well**	**Direct Push method**	**16.6.2010**	**5,98 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **300,349**	Top of Casing altitude: Z=

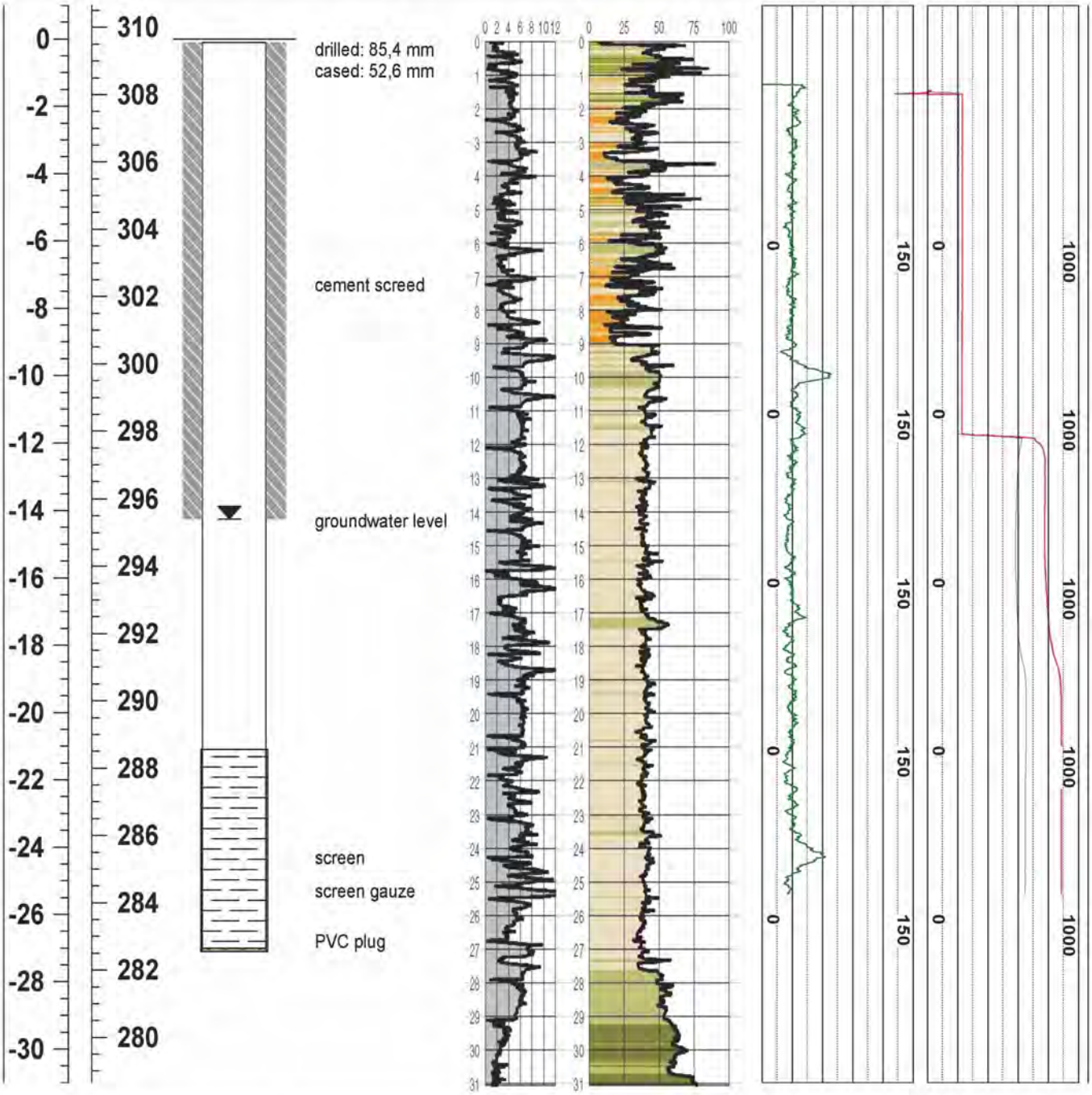


Object: **INC-3d**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **7**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-4D	**Observation well**	**Direct Push method**	**16.6.2010**	**14,25 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **309,653**	Top of Casing altitude: Z=

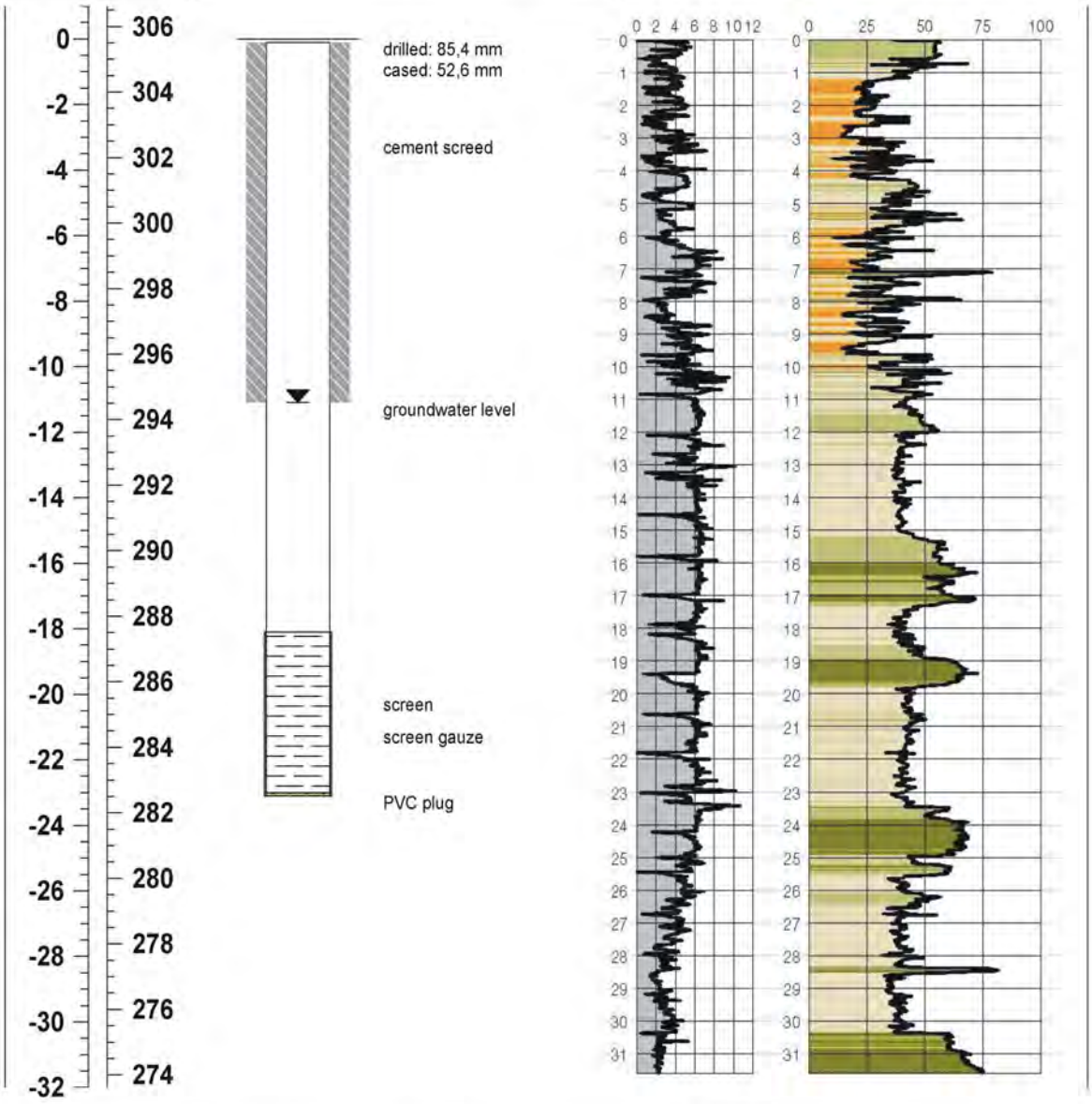


Object: **INC-4D**	Contractor:	Legend:
Claimer:	**Geo-log, GmbH; University of Göttingen**	Electr. Conductivity (mS/m) / Interpretation: 0 - 30 GRAVEL - SAND; 30 - 45 SAND, silty; 45 - 60 SAND, very silty; 60 - 80 SILT; 80 - 200 SILT - CLAY; > 200 not interpretable; Absolute Conductivity; Conductivity at 25 °C; (GeoZS, 2011)
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **8**	**Matoz, T.**	

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-5d	**Observation well**	**Direct Push method**	**21.6.2010**	**11,09 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **305,617**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)

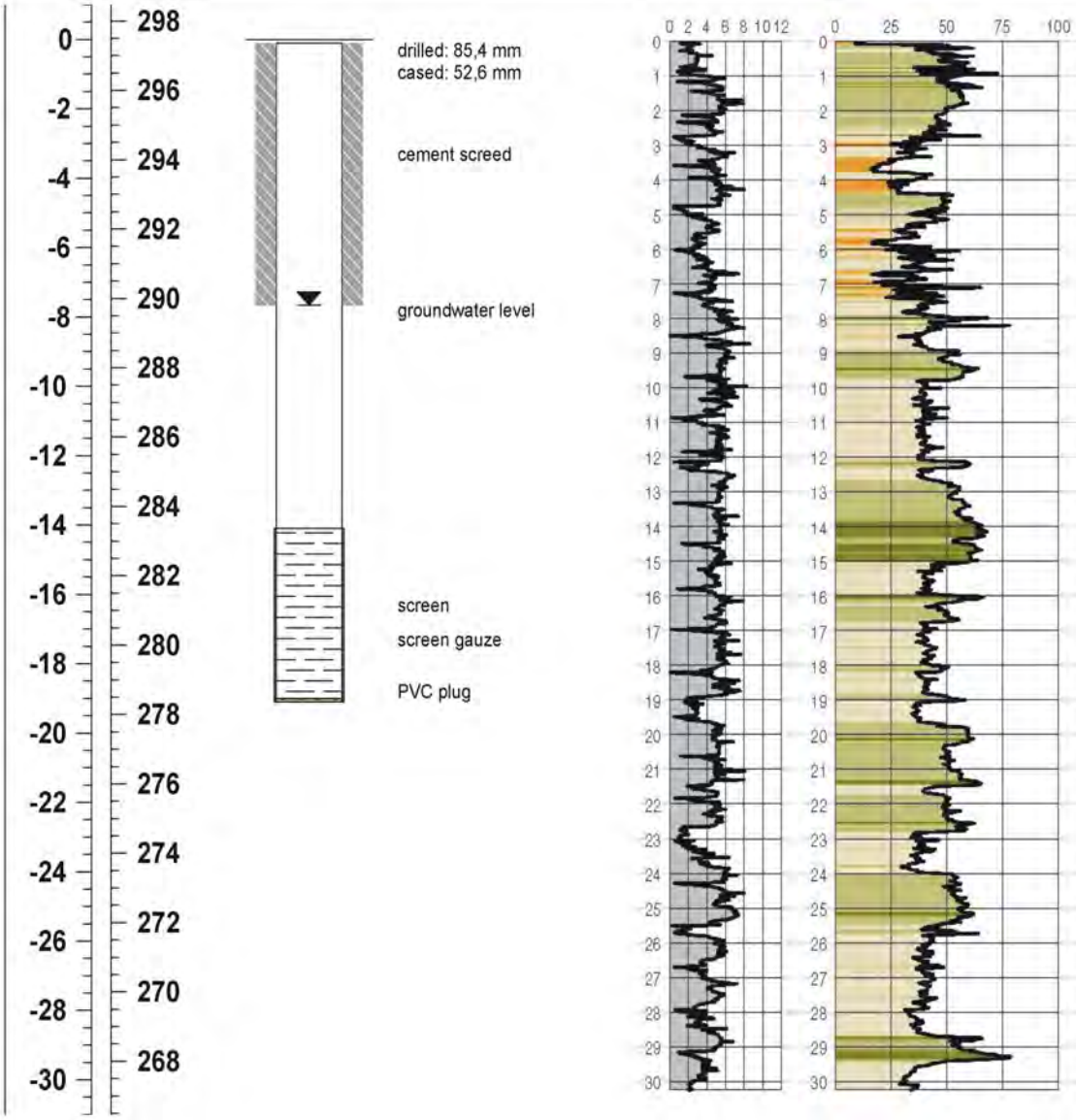


Object: **INC-5d**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **9**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-6d	**Observation well**	**Direct Push method**	**22.6.2010**	**7,66 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **297,465**	Top of Casing altitude: Z=



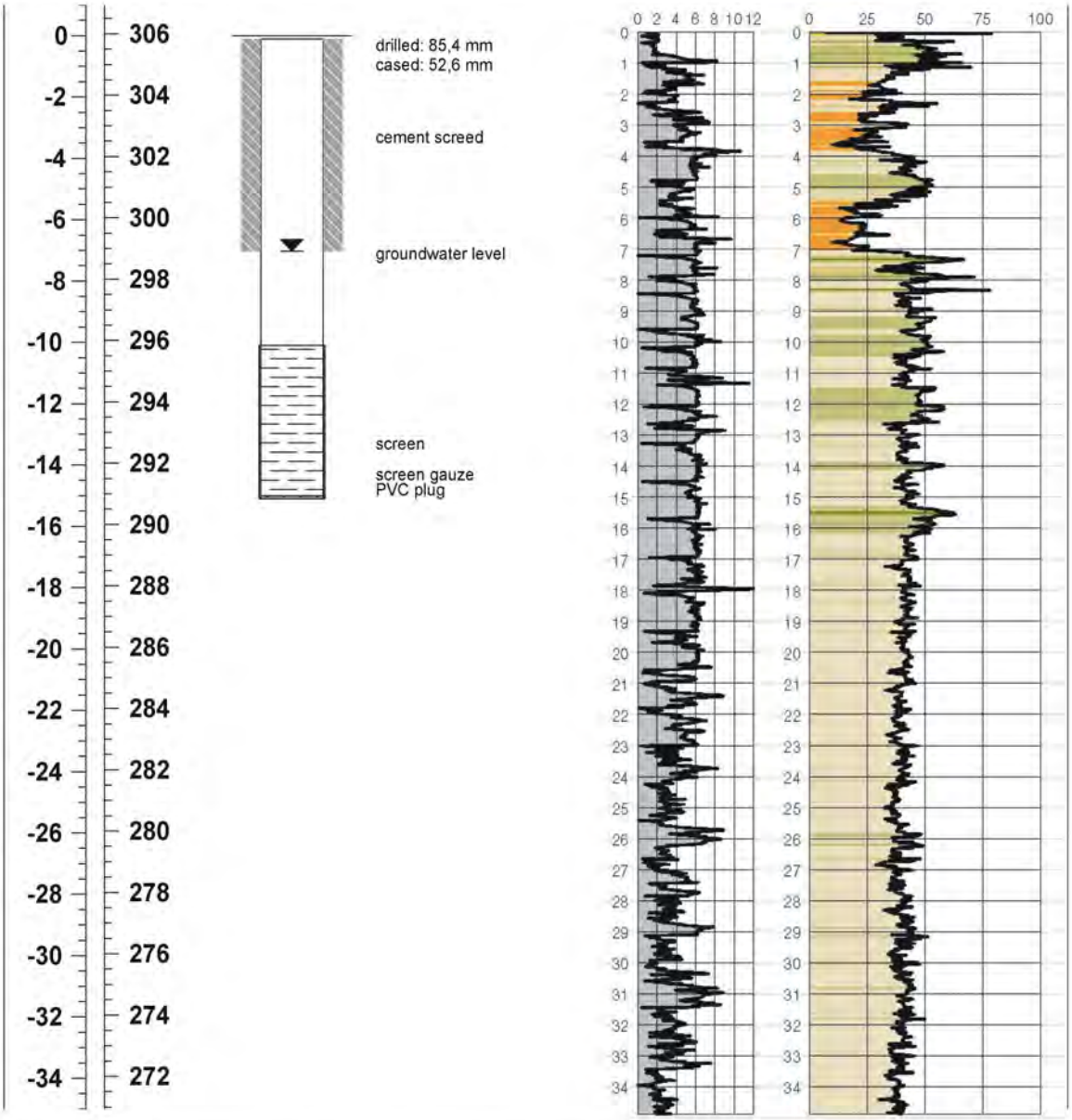
Object: **INC-6d**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **10**		

Electr. Conductivity (mS/m)	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-7s	**Observation well**	**Direct Push method**	**23.6.2010**	**7,03 m**
Location: **Brest**	X=	Y=	Field altitude: Z= **305,938**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)



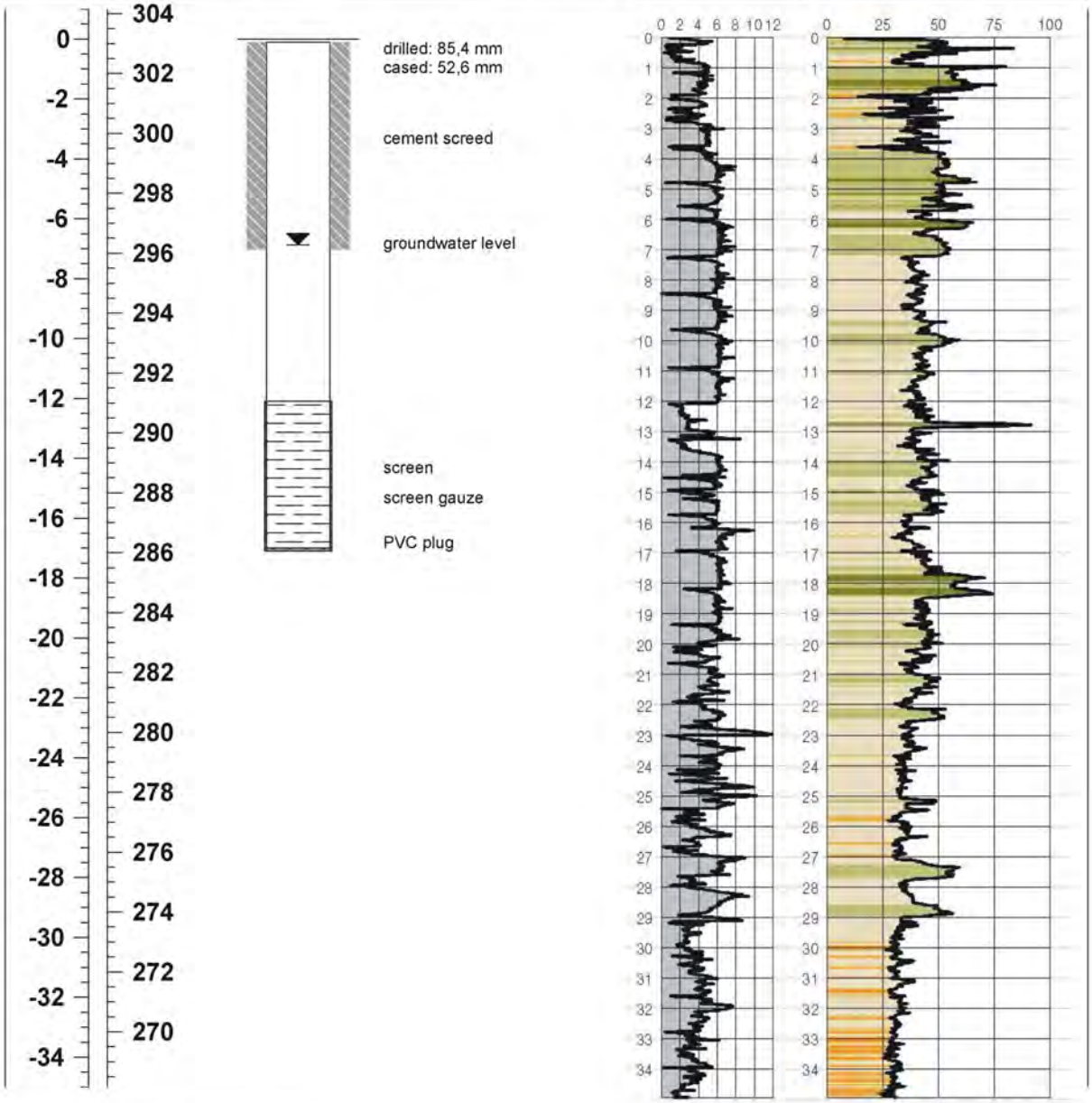
Object: **INC-7s**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **11**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-8s	**Observation well**	**Direct Push method**	**24.6.2010**	**6,87 m**
Location: **Brest**	X=	Y=	Field altitude: **Z= 303,151**	Top of Casing altitude: Z=

Deep	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/m)



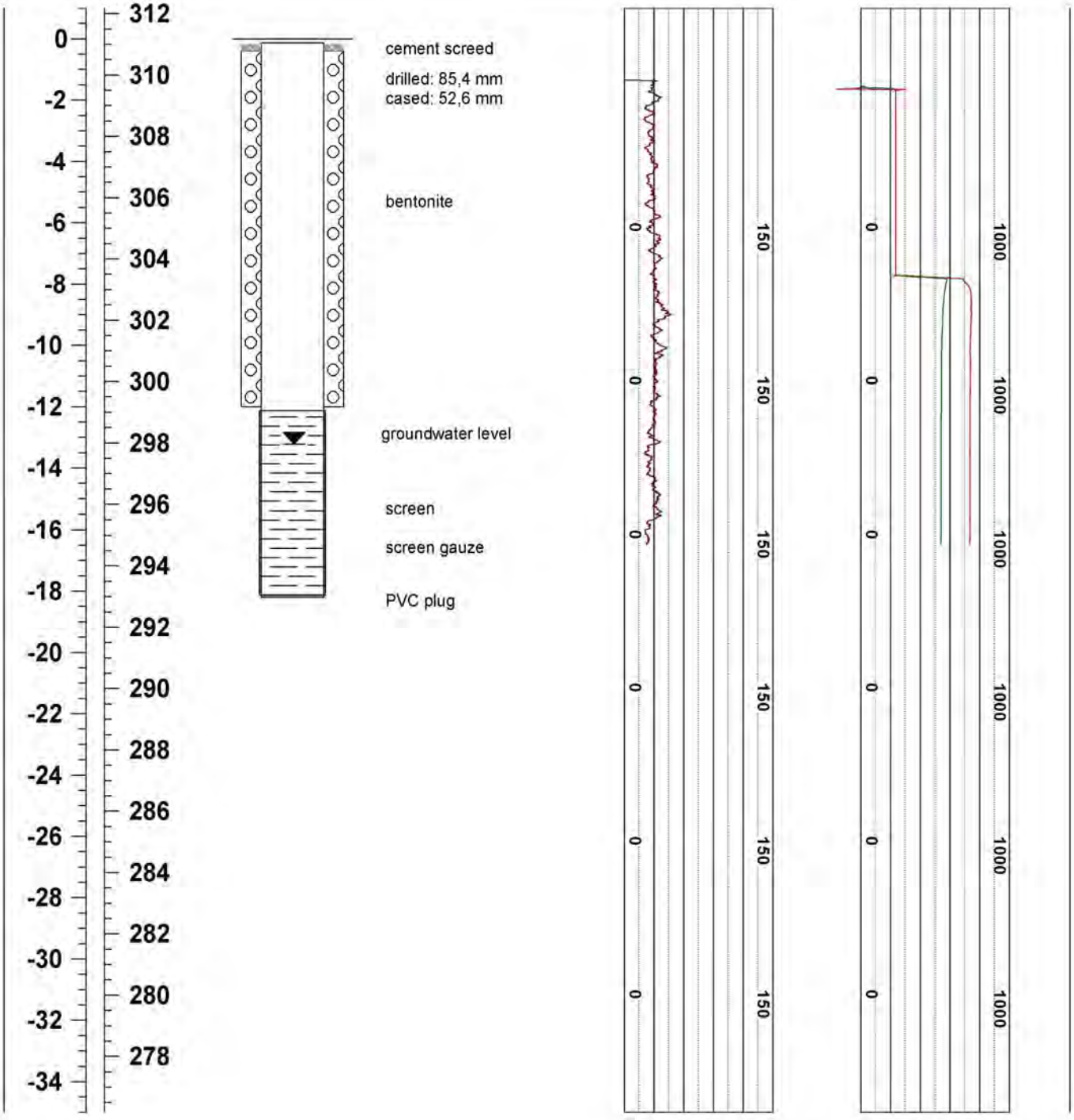
Object: **INC-8s**	Contractor:	Legende:
Claimer:	**Geo-log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **12**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-10S	**Observation well**	**Direct Push Method**	**20.10.2010**	**Z= 297,98**
Location: **Brest**	X=	Y=	Field altitude: Z= **311,18**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

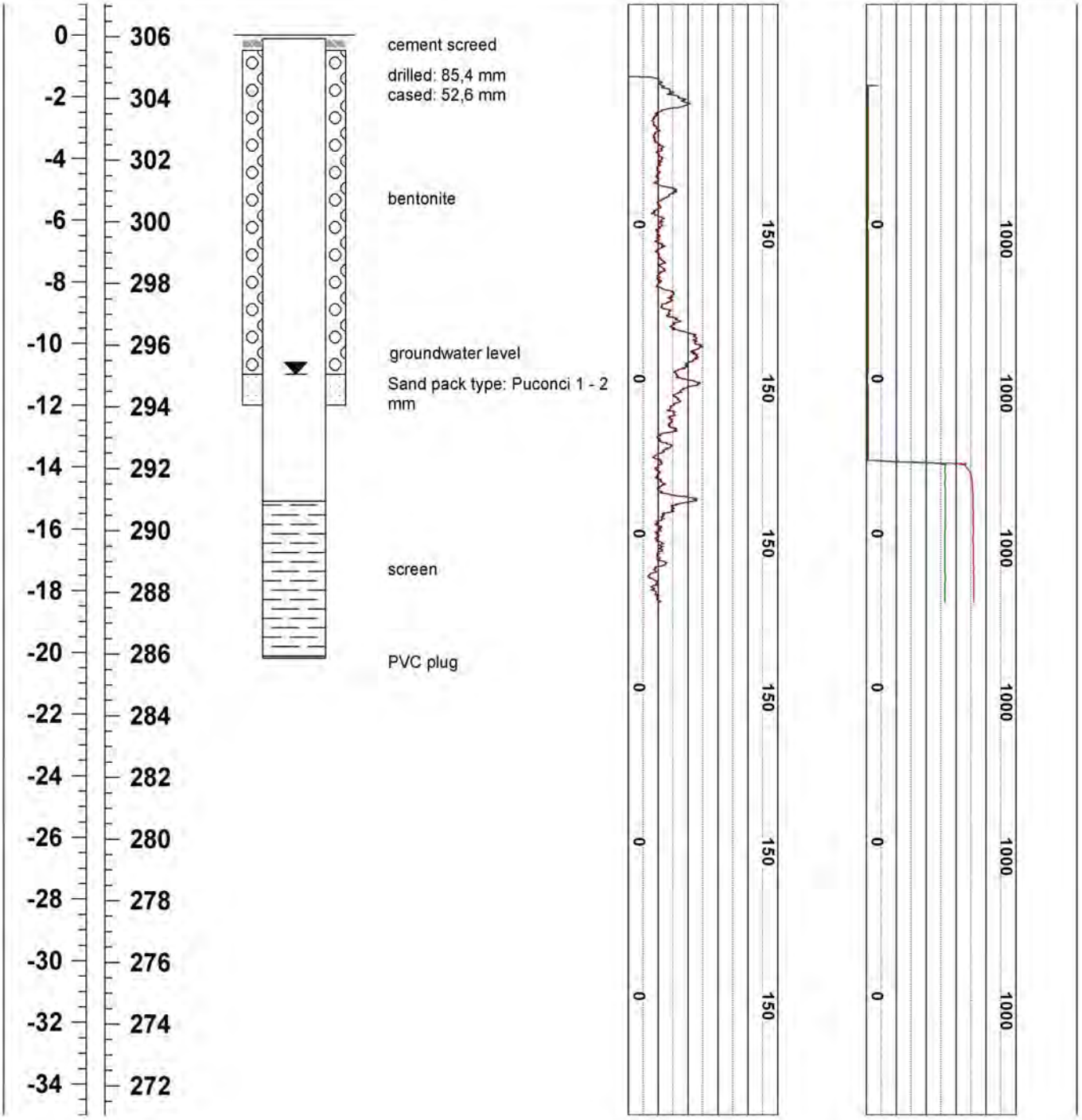


Object: **INC-10S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **13**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-11S	**Observation well**	**Direct Push Method**	**21.10.2010**	**Z= 294,86**
Location: **Brest**	X=	Y=	Field altitude: **Z= 306,059**	Top of Casing altitude: Z=

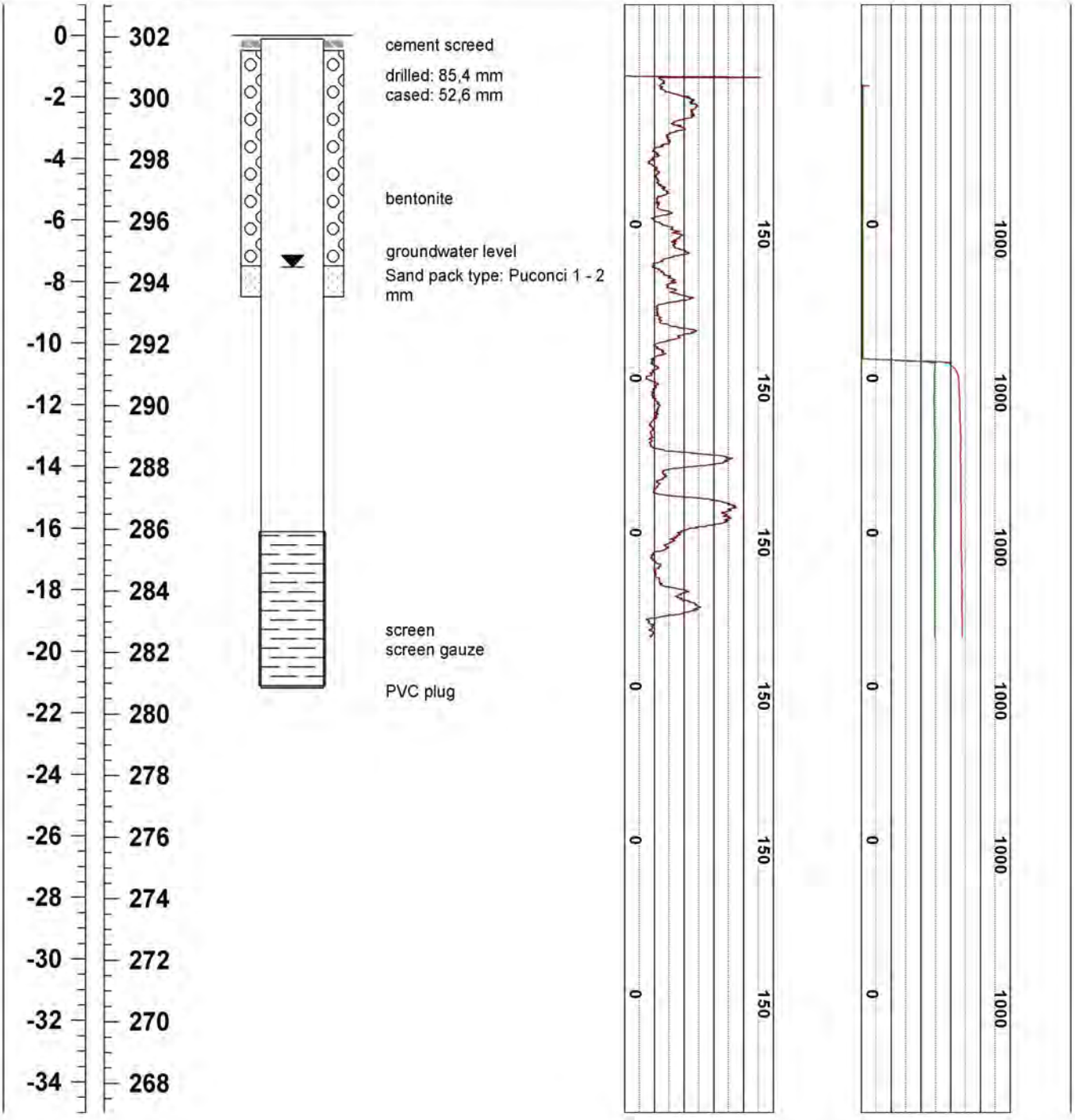
Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)



Object: **INC-11S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **14**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-12S	**Observation well**	**Direct Push Method**	**22.10.2010**	**Z= 294,45**
Location: **Brest**	X=	Y=	Field altitude: **Z= 302,048**	Top of Casing altitude: Z=

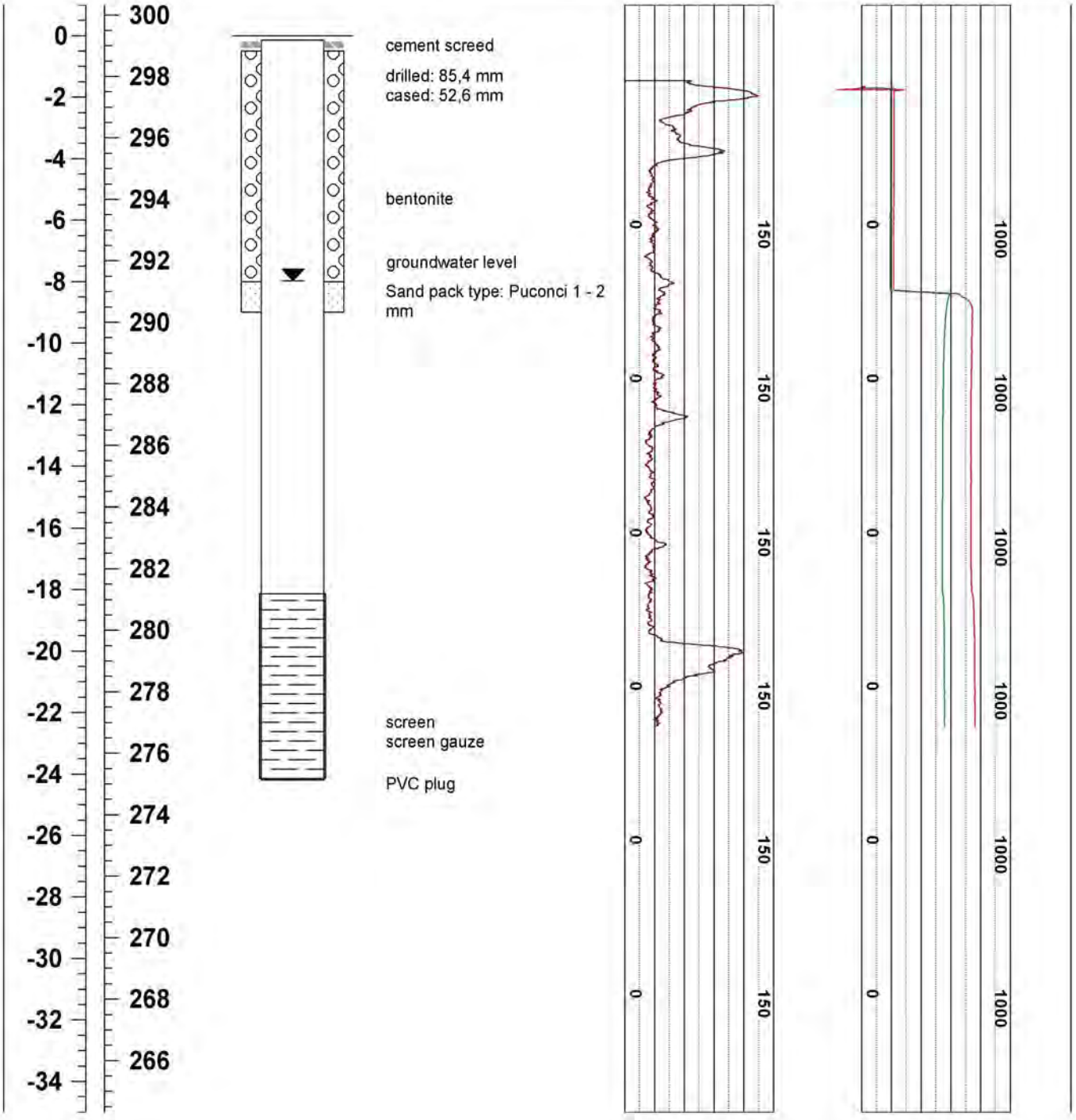


Object: **INC-12S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **15**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-13D	**Observation well**	**Direct Push Method**	**23.10.2010**	**Z= 291.33**
Location: **Brest**	X=	Y=	Field altitude: Z= **299,324**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

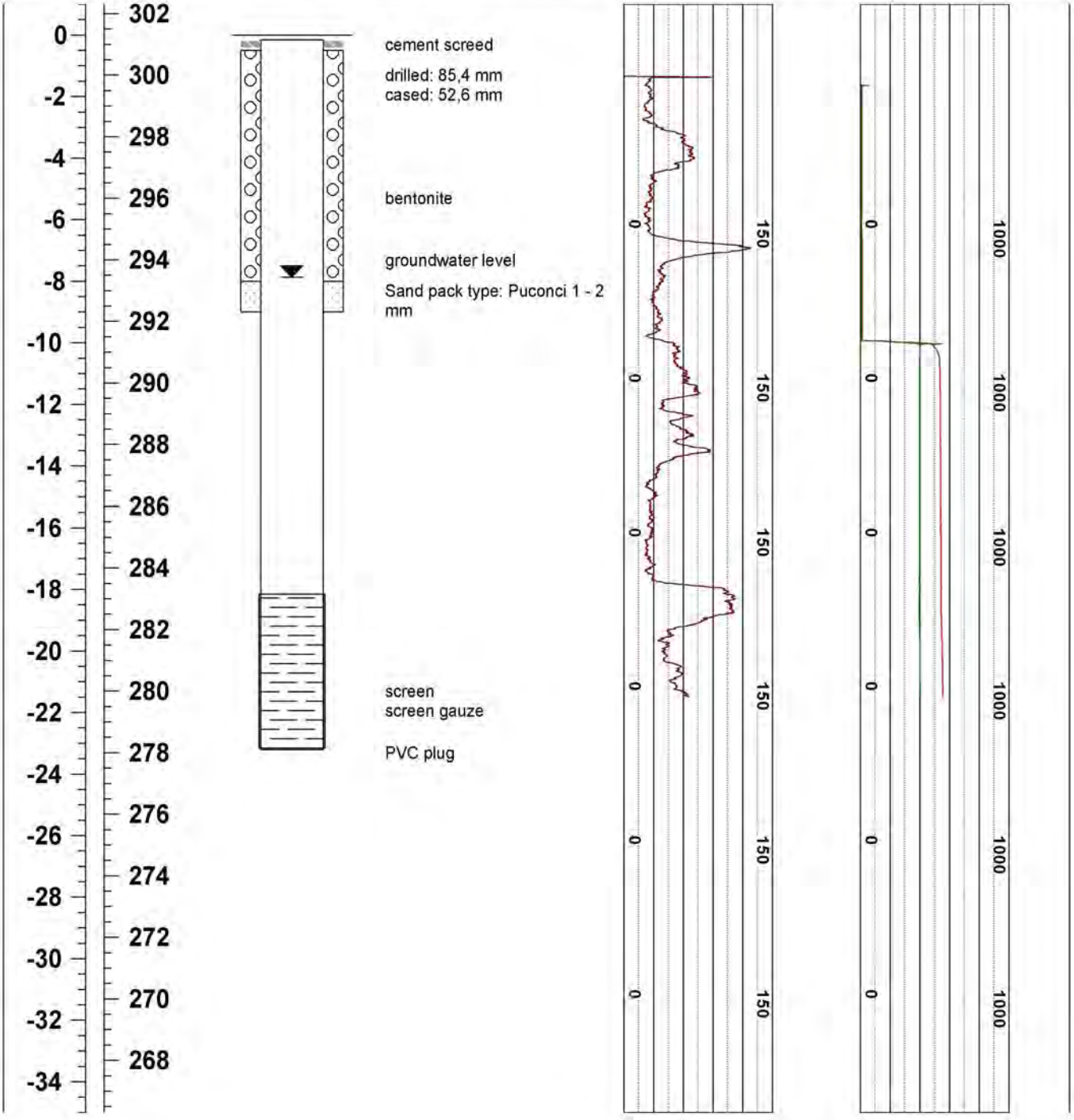


Object: **INC-13D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **16**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-14D	**Observation well**	**Direct Push Method**	**23.10.2010**	**Z= 293,37**
Location: **Brest**	X=	Y=	Field altitude: Z= **301,305**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

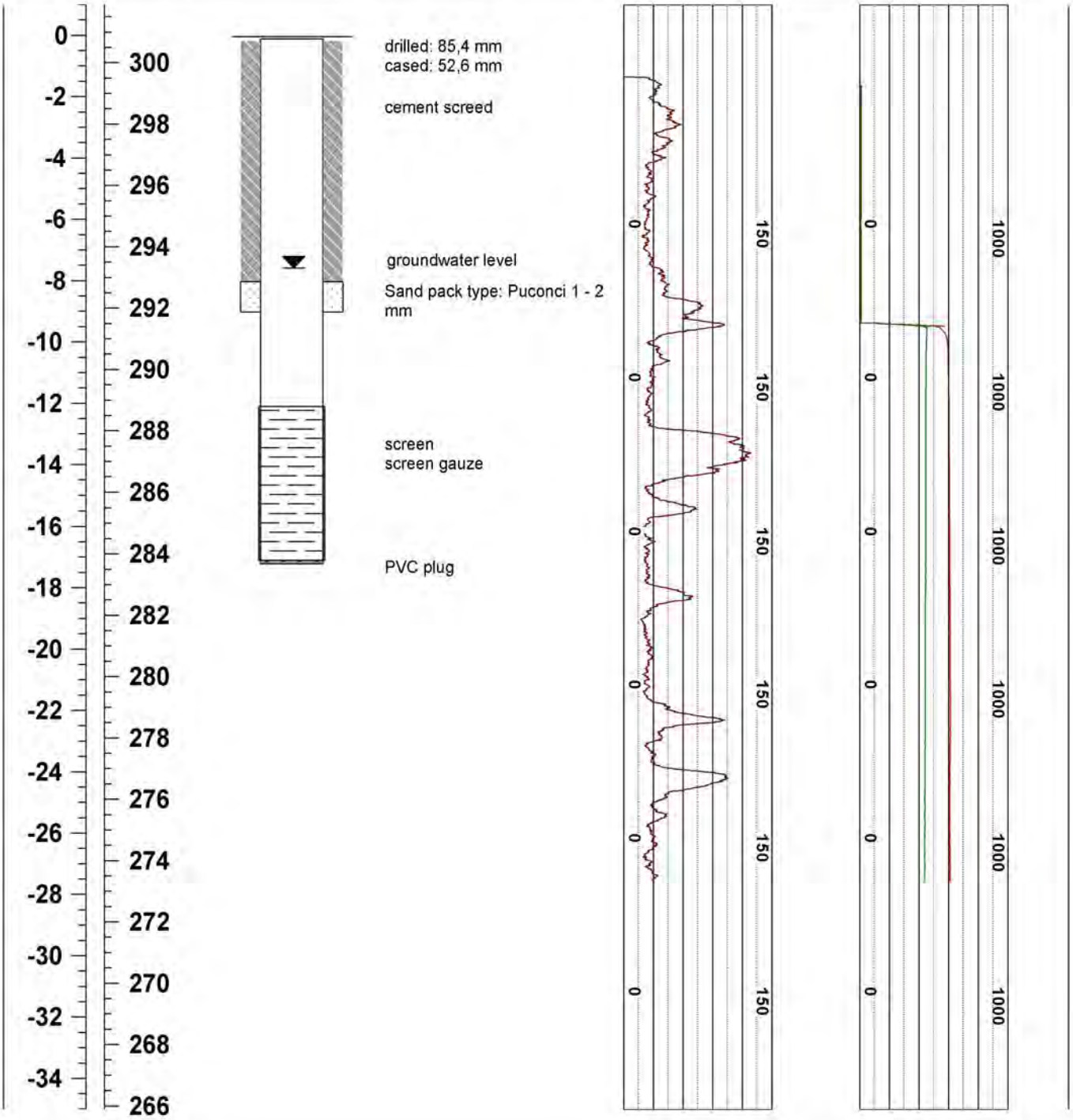


Object: **INC-14D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **17**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-15S	**Observation well**	**Direct Push Method**	**28.10.2010**	**Z= 293,17**
Location: **Brest**	X=	Y=	Field altitude: Z= **300,891**	Top of Casing altitude: Z=

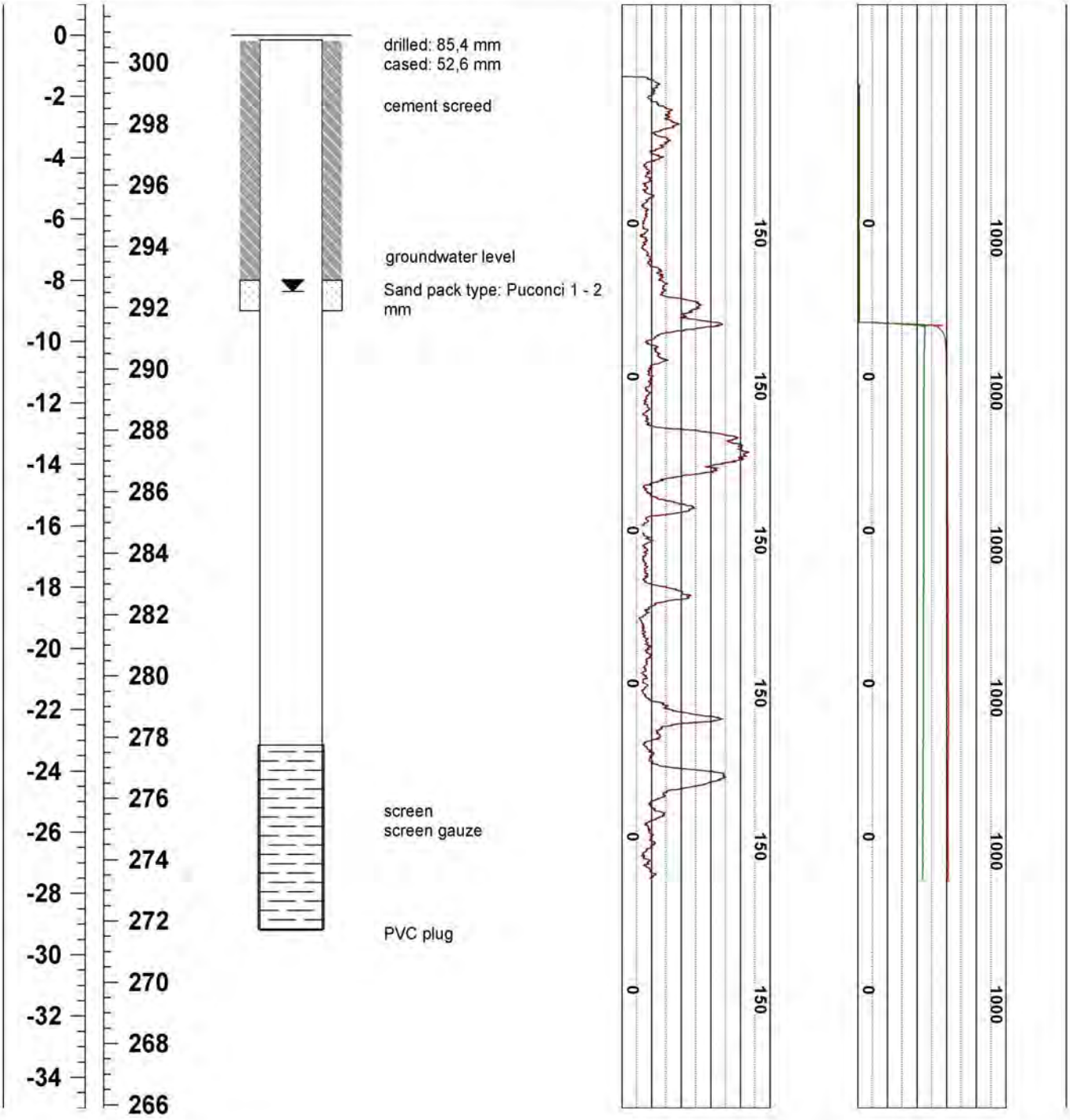
Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)



Object: **INC-15S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **18**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-15D	**Observation well**	**Direct Push Method**	**28.10.2010**	**Z= 292,64**
Location: **Brest**	X=	Y=	Field altitude: **Z= 300,897**	Top of Casing altitude: Z=

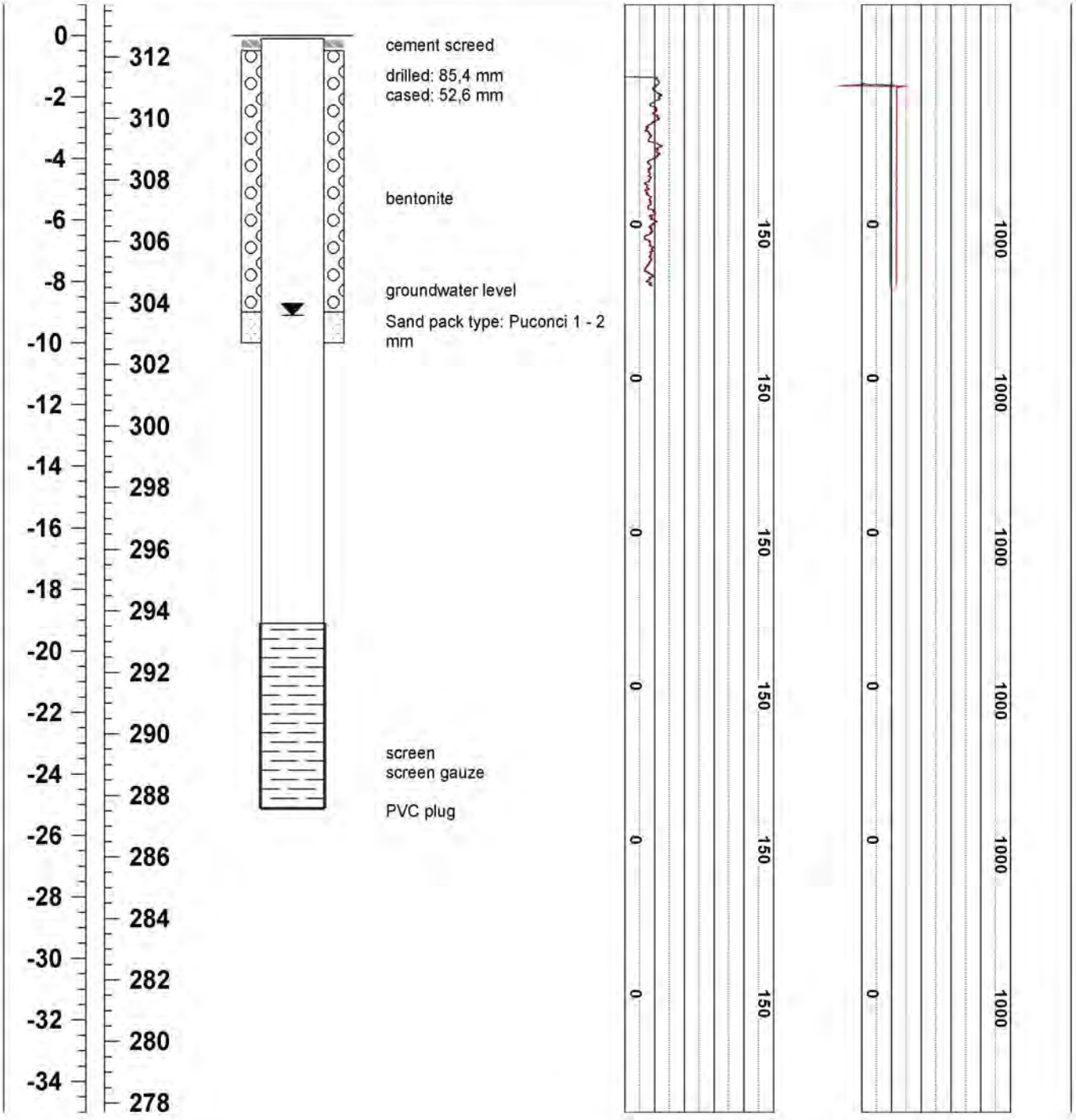


Object: **INC-15D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **19**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-16D	**Observation well**	**Direct Push Method**	**25.10.2010**	**Z= 303,44**
Location: **Brest**	X=	Y=	Field altitude: **Z= 312,699**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

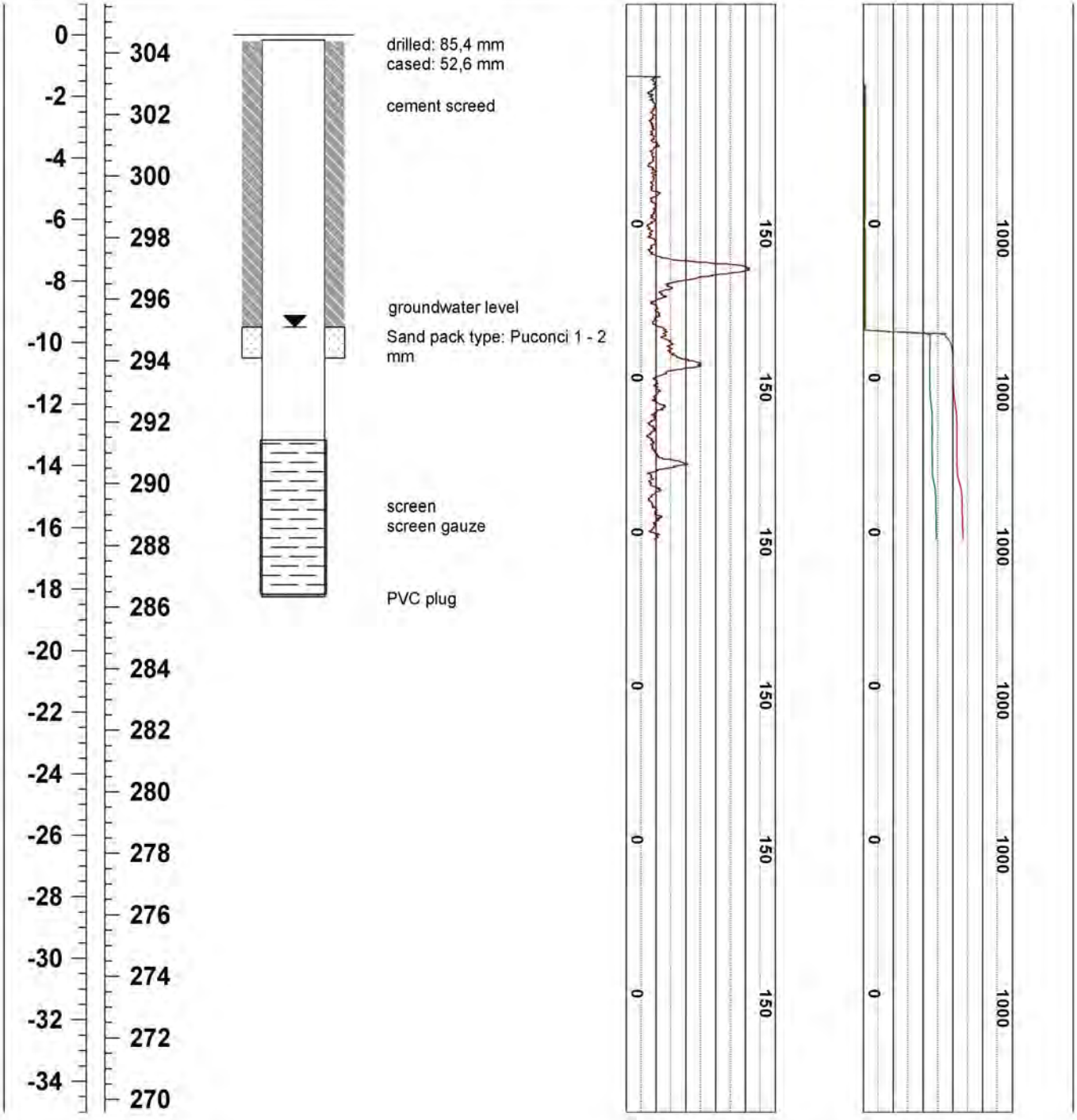


Object: **INC-16D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **20**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-17S	**Observation well**	**Direct Push Method**	**26.10.2010**	**Z= 294,90**
Location: **Brest**	X=	Y=	Field altitude: **Z= 304,589**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

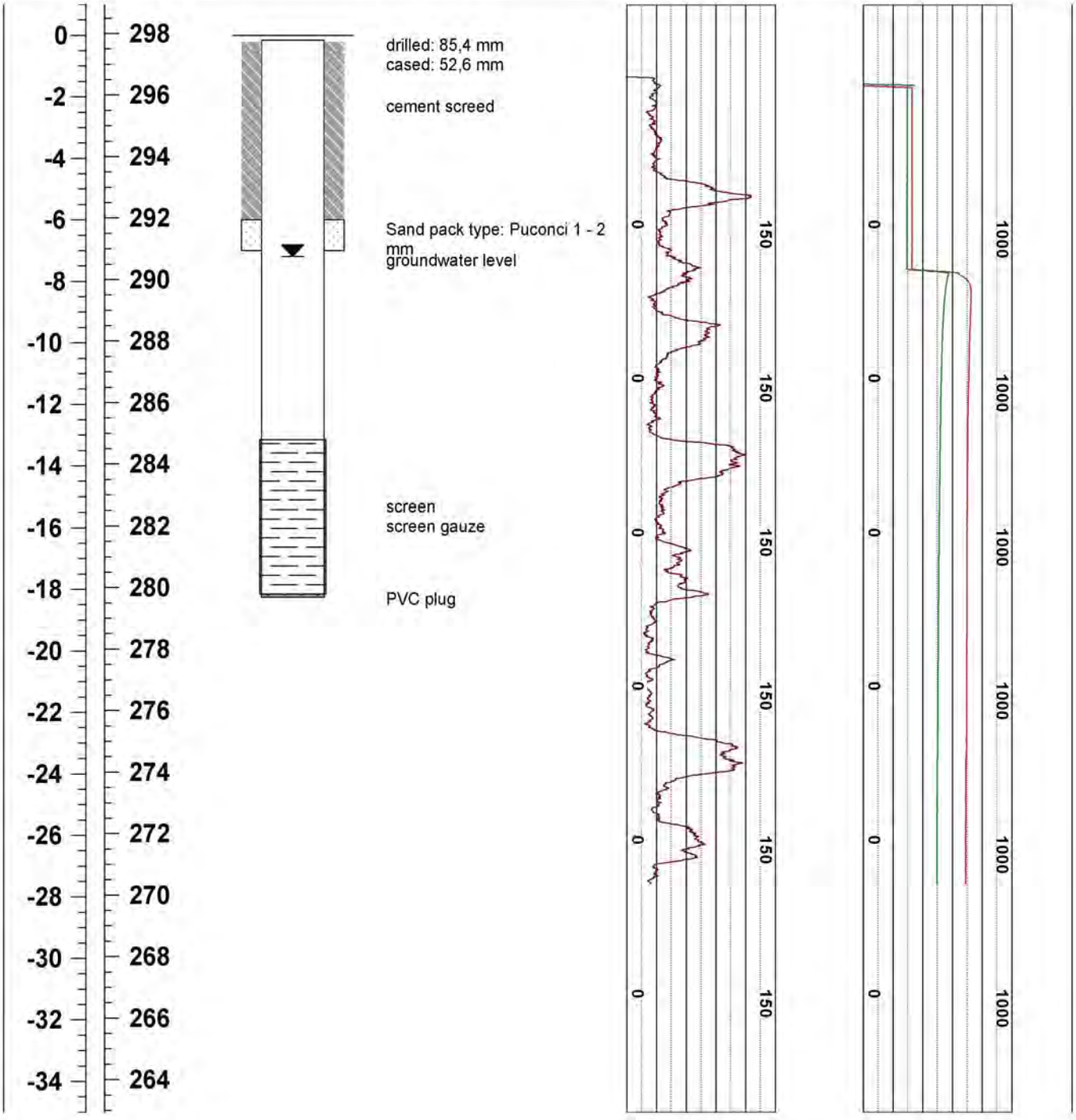


Object: **INC-17S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **21**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-18S	**Observation well**	**Direct Push Method**	**26.10.2010**	**Z= 290,6**
Location: **Brest**	X=	Y=	Field altitude: Z= **297,94**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

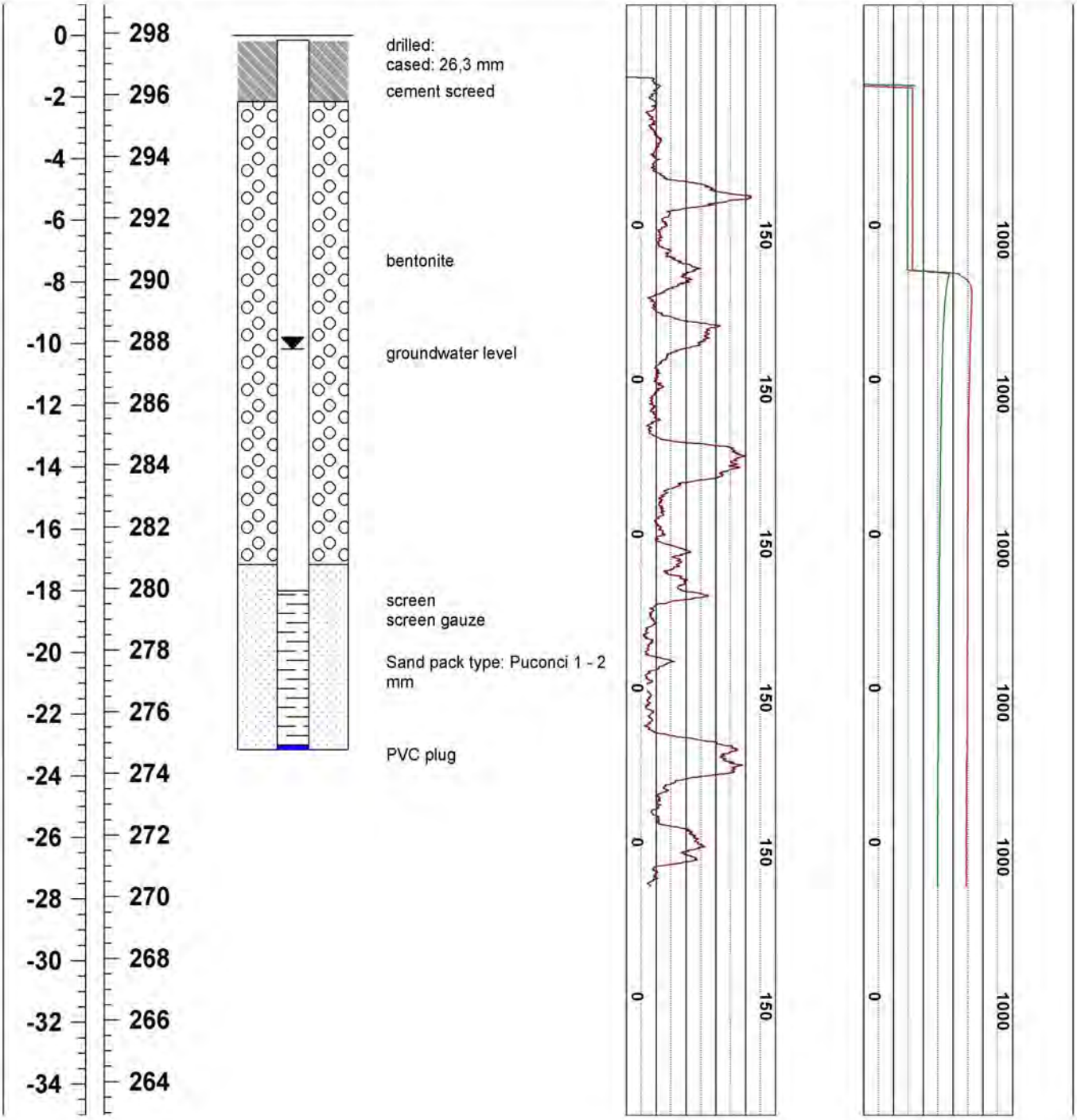


Object: **INC-18S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **22**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-18M	**Observation well**	**Direct Push Method**	**15.11.2011**	**Z= 287,593**
Location: **Brest**	X=	Y=	Field altitude: **Z= 297,923**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

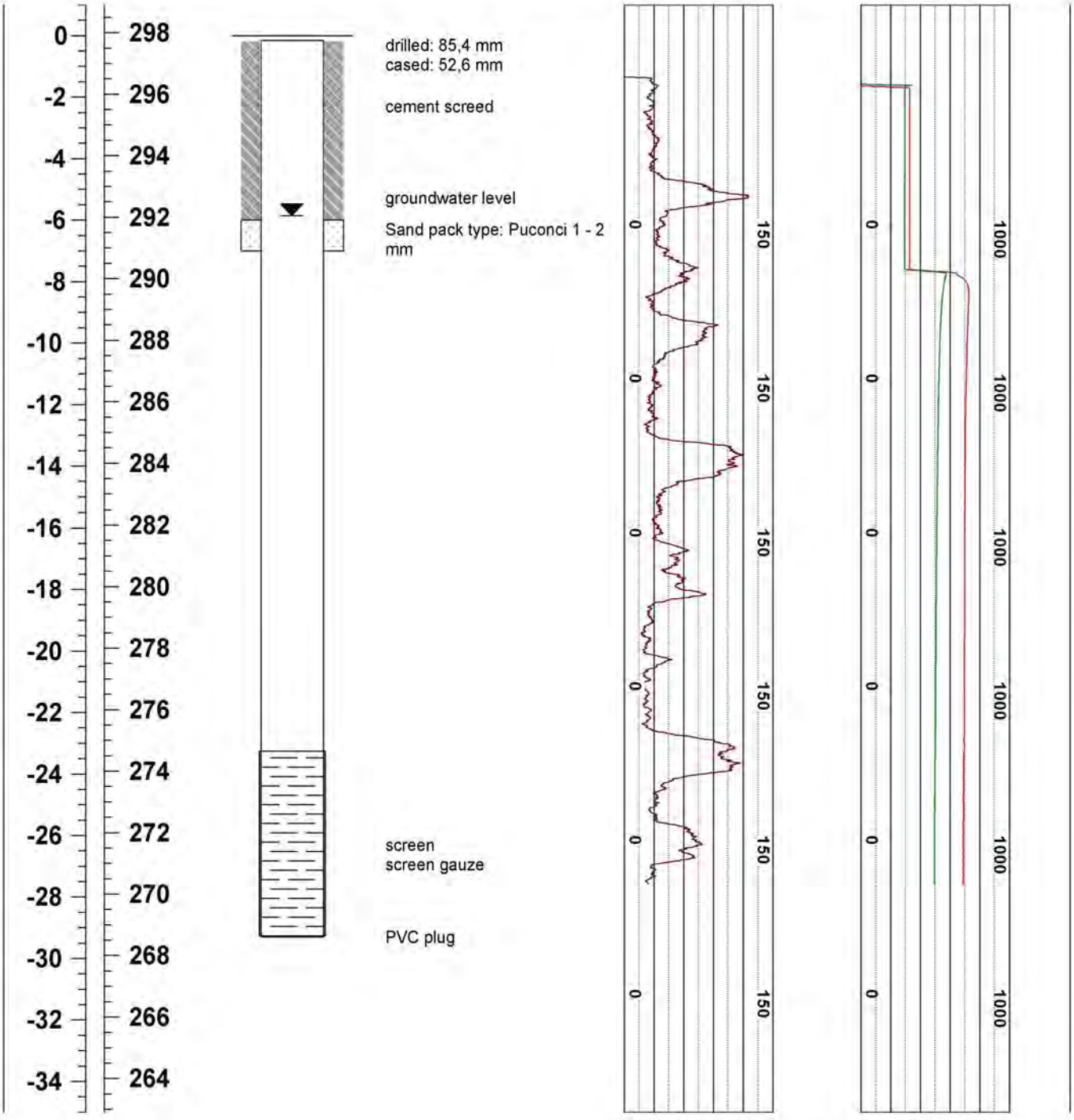


Object: **INC-18M**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **23**	**Matoz, T.**	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-18D	**Observation well**	**Direct Push Method**	**27.10.2010**	**Z= 291,97**
Location: **Brest**	X=	Y=	Field altitude: **Z= 297,905**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

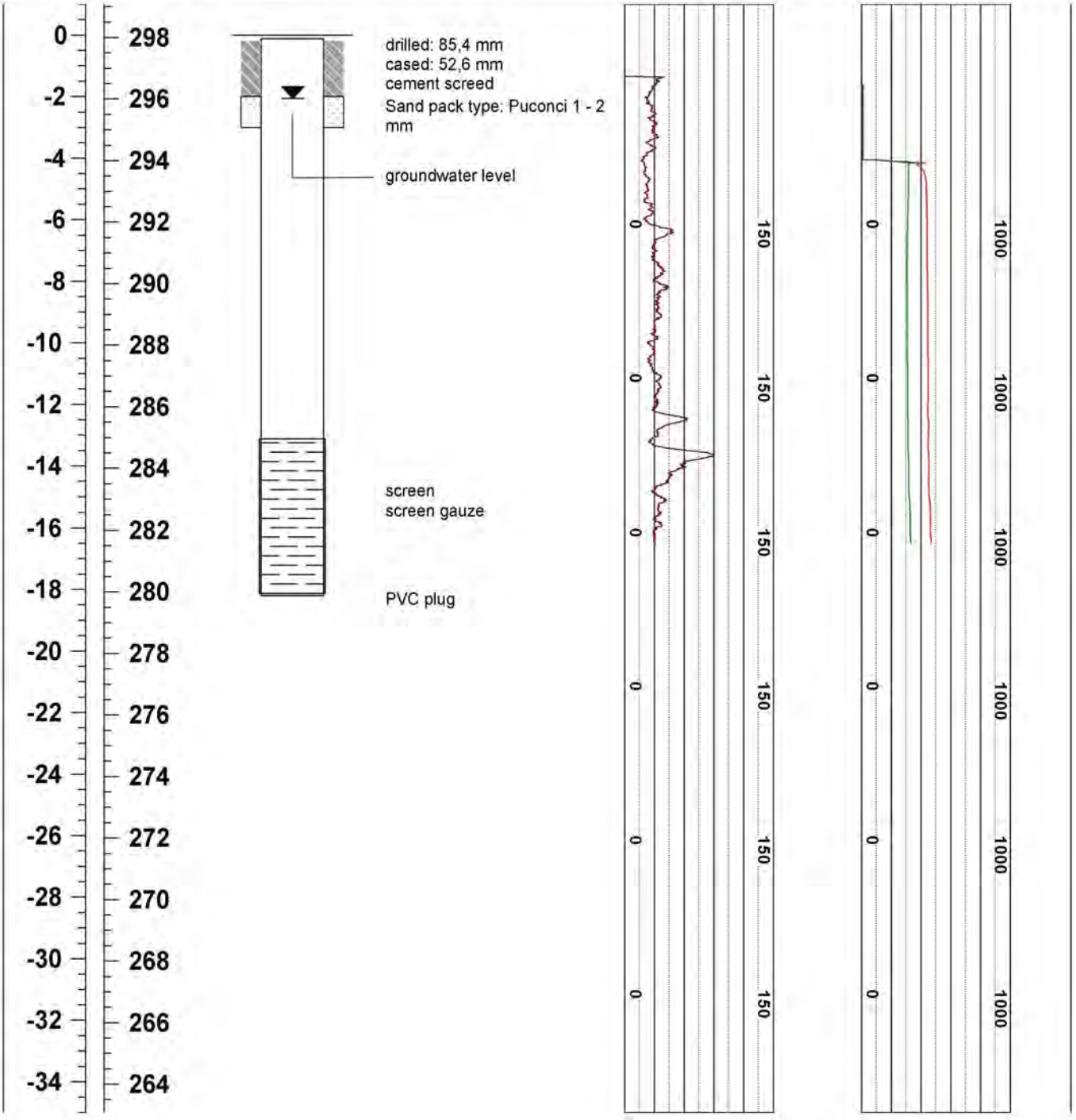


Object: **INC-18D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **24**	Matoz, T.	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-19S	**Observation well**	**Direct Push Method**	**29.10.2010**	**Z= 295,81**
Location: **Brest**	X=	Y=	Field altitude: **Z= 298,079**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Natural Gamma	Electrical Conductivity (mS/cm)

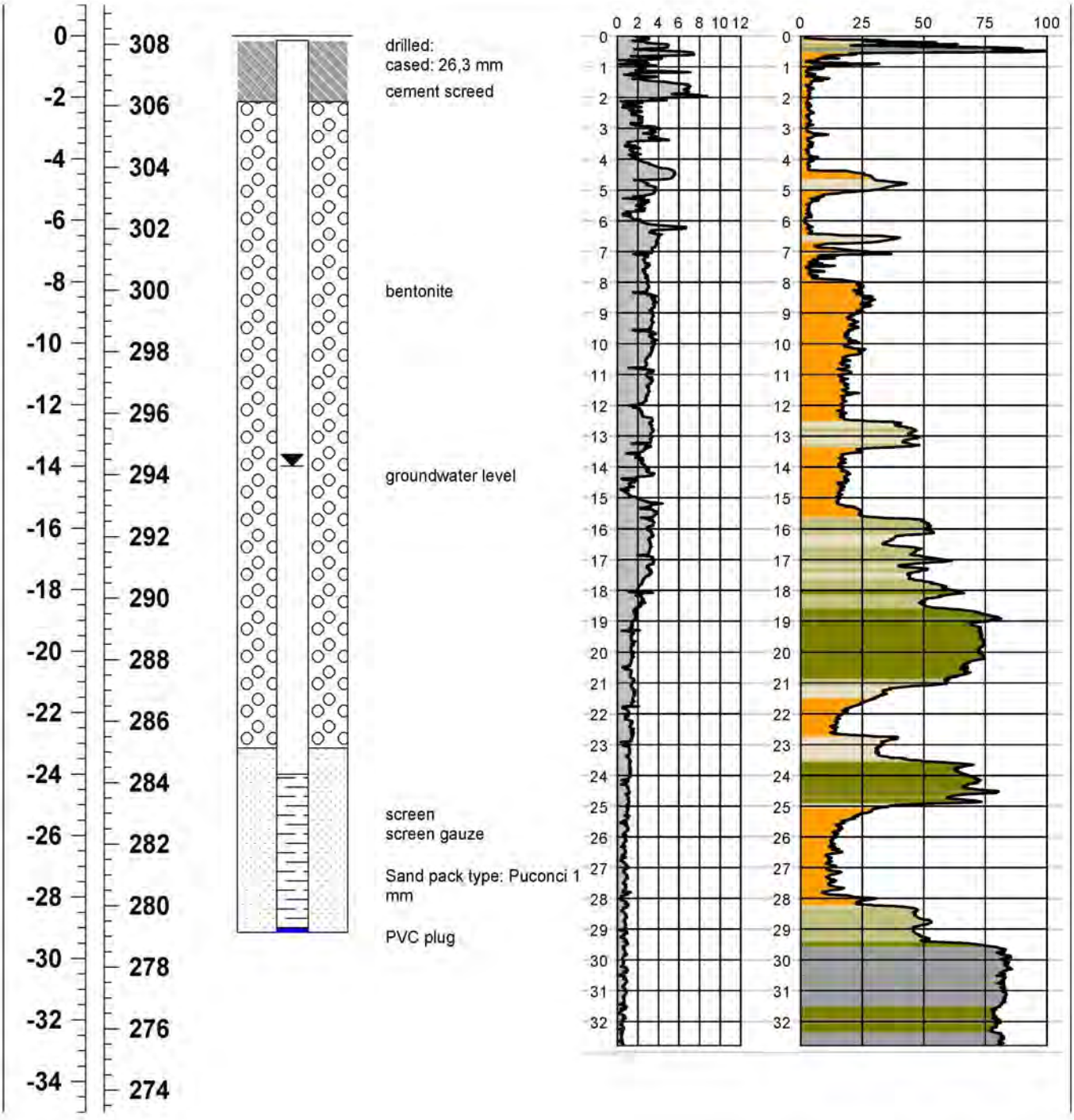


Object: **INC-19S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	Absolute Conductivity
Scale (vertical):	Processed: **Meglič P., Šram D.**	Conductivity at 25 °C
Appendix: **25**	**Matoz, T.**	(GeoZS, 2011)

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-30D	**Observation well**	**Direct Push Method**	**24.10.2011**	**Z= 294,131**
Location: **Brest**	X=	Y=	Field altitude: **Z= 308,281**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



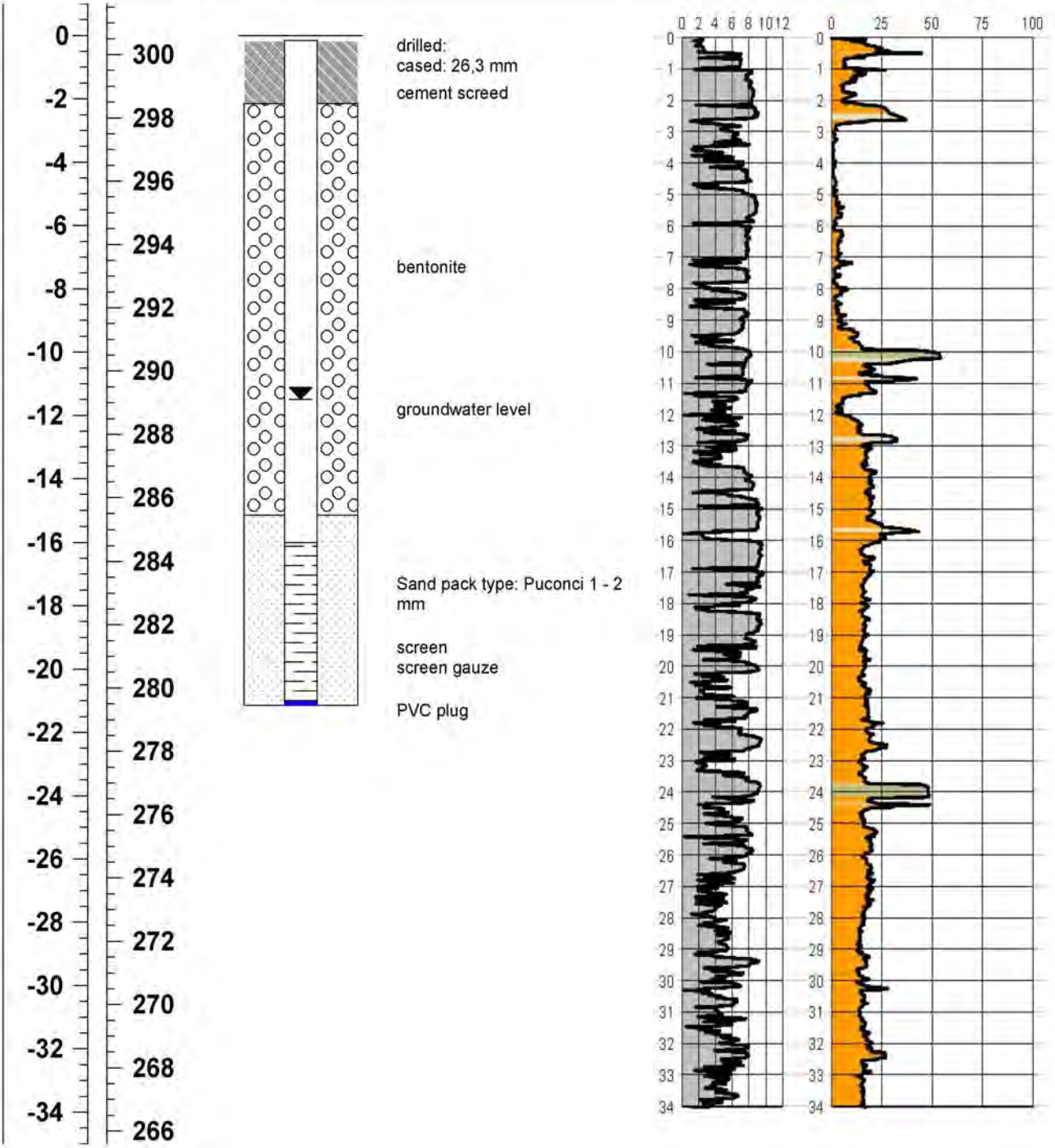
Object: **INC-30D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **26**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-31S	**Observation well**	**Direct Push Method**	**25.10.2011**	**Z= 288,681**
Location: **Brest**	X=	Y=	Field altitude: **Z= 300,601**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



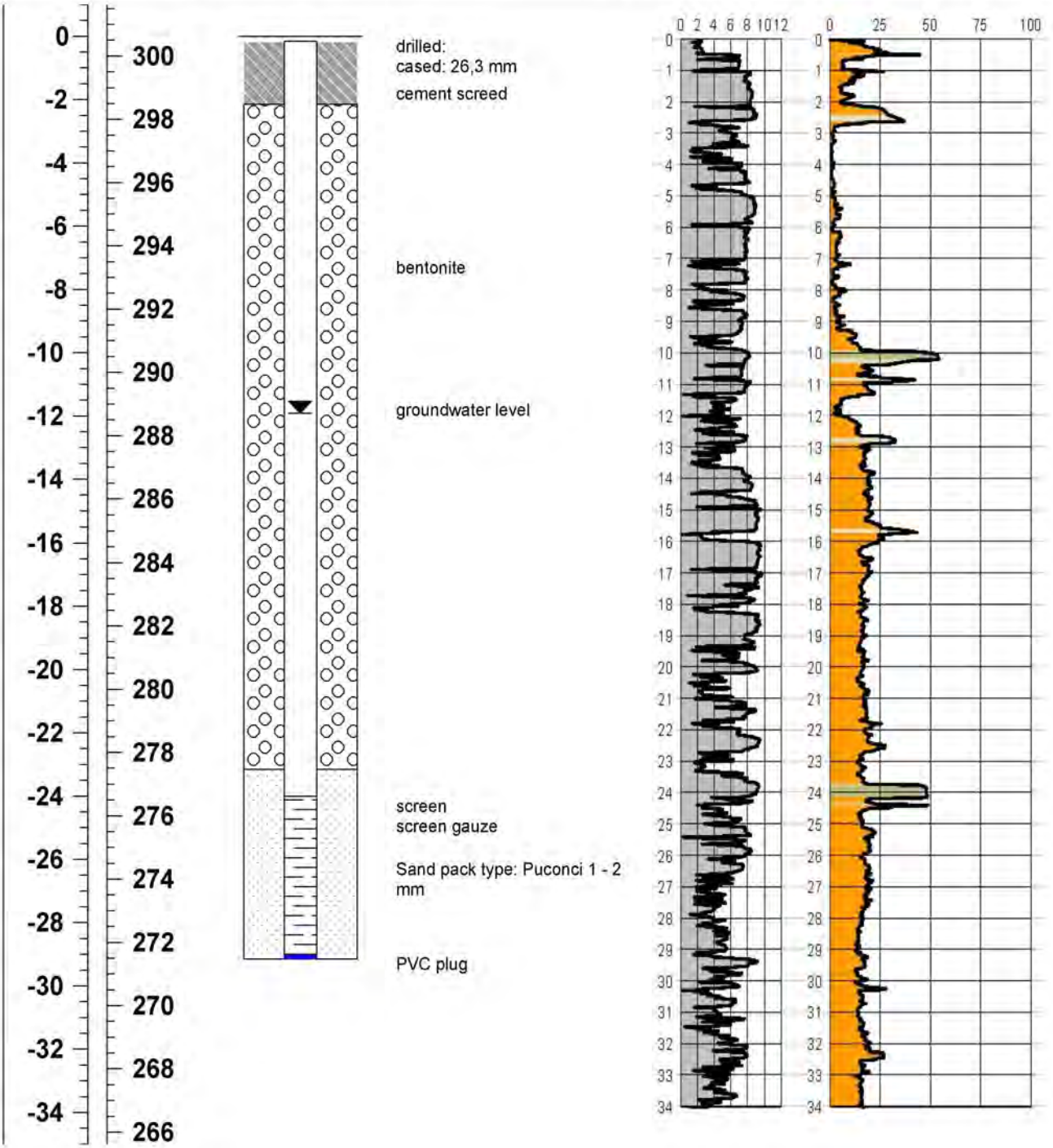
Object: **INC-31S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **27**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-31D	**Observation well**	**Direct Push Method**	**25.10.2011**	**Z= 288,563**
Location: **Brest**	X=	Y=	Field altitude: Z= **300,623**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



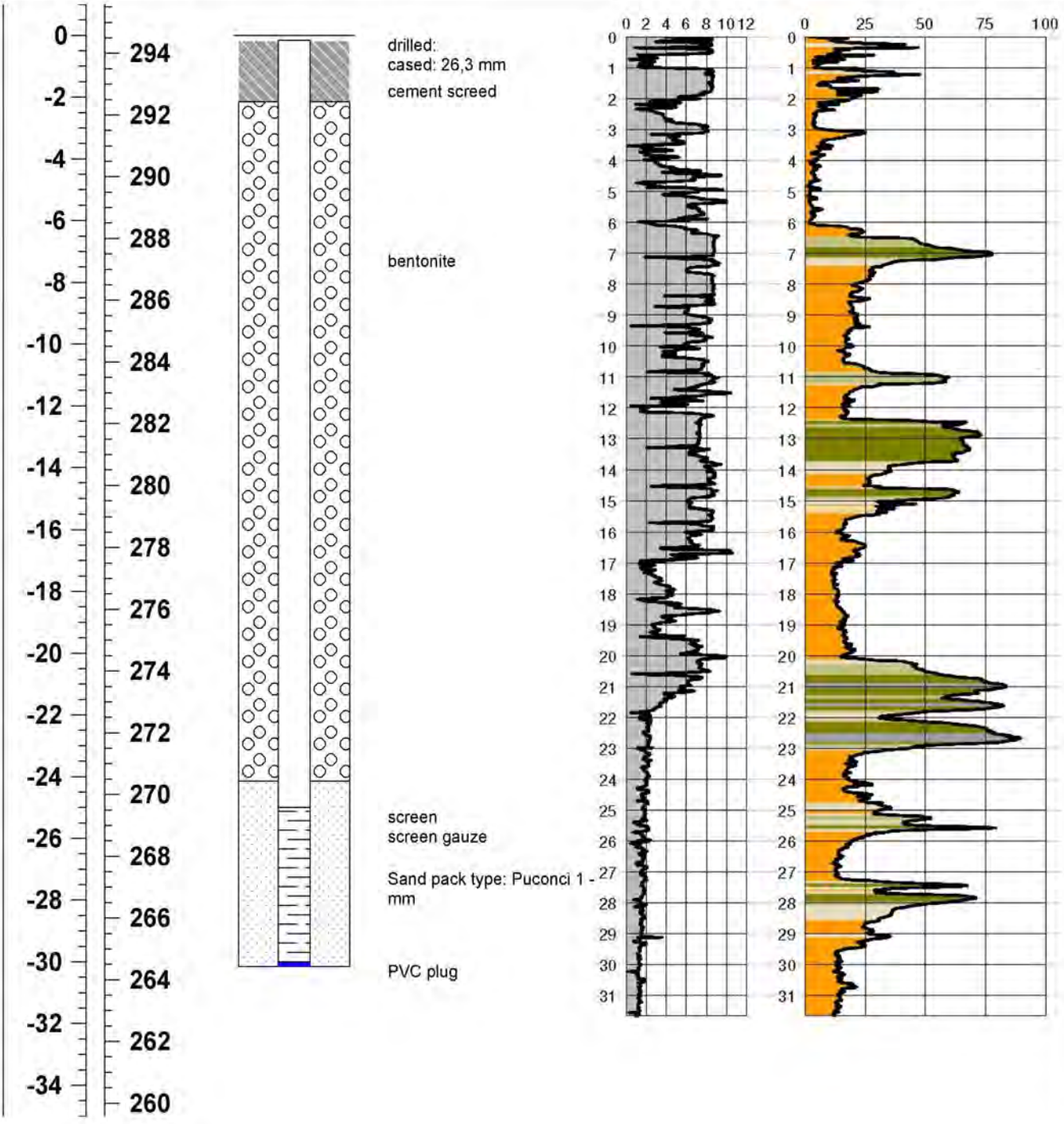
Object: **INC-31D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **28**		

Elect. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-32D	**Observation well**	**Direct Push Method**	**26.10.2011**	
Location: **Brest**	X=	Y=	Field altitude: Z= **294,580**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



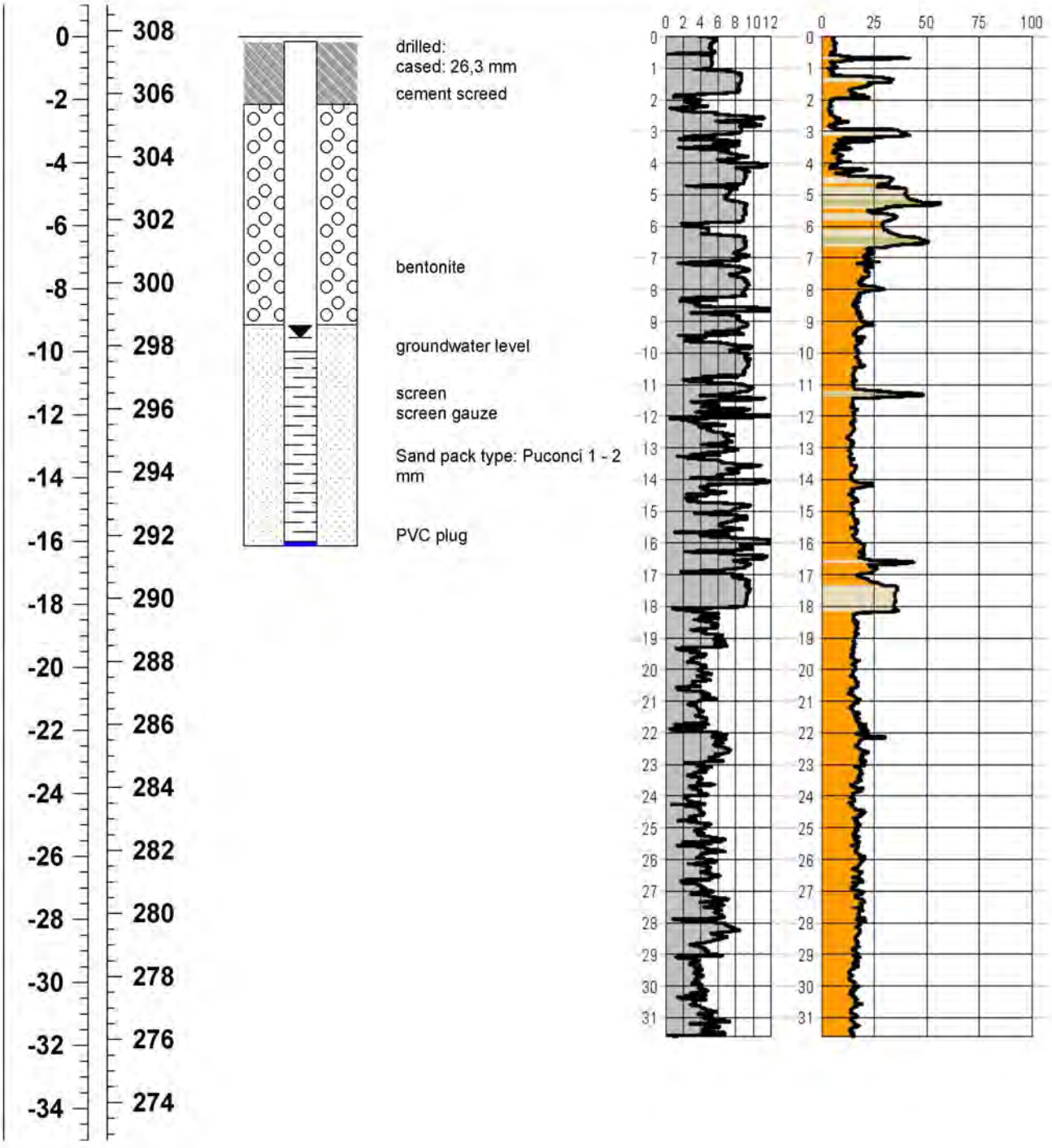
Object: **INC-32D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **29**		

Electr. Conductivity (mS/m)	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

Name:	Well type:	Drill method:	Date:	GWLD:
INC-33S	**Observation well**	**Direct Push Method**	**27.10.2011**	**Z= 298,099**
Location: **Brest**	X=	Y=	Field altitude: **Z= 307,809**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



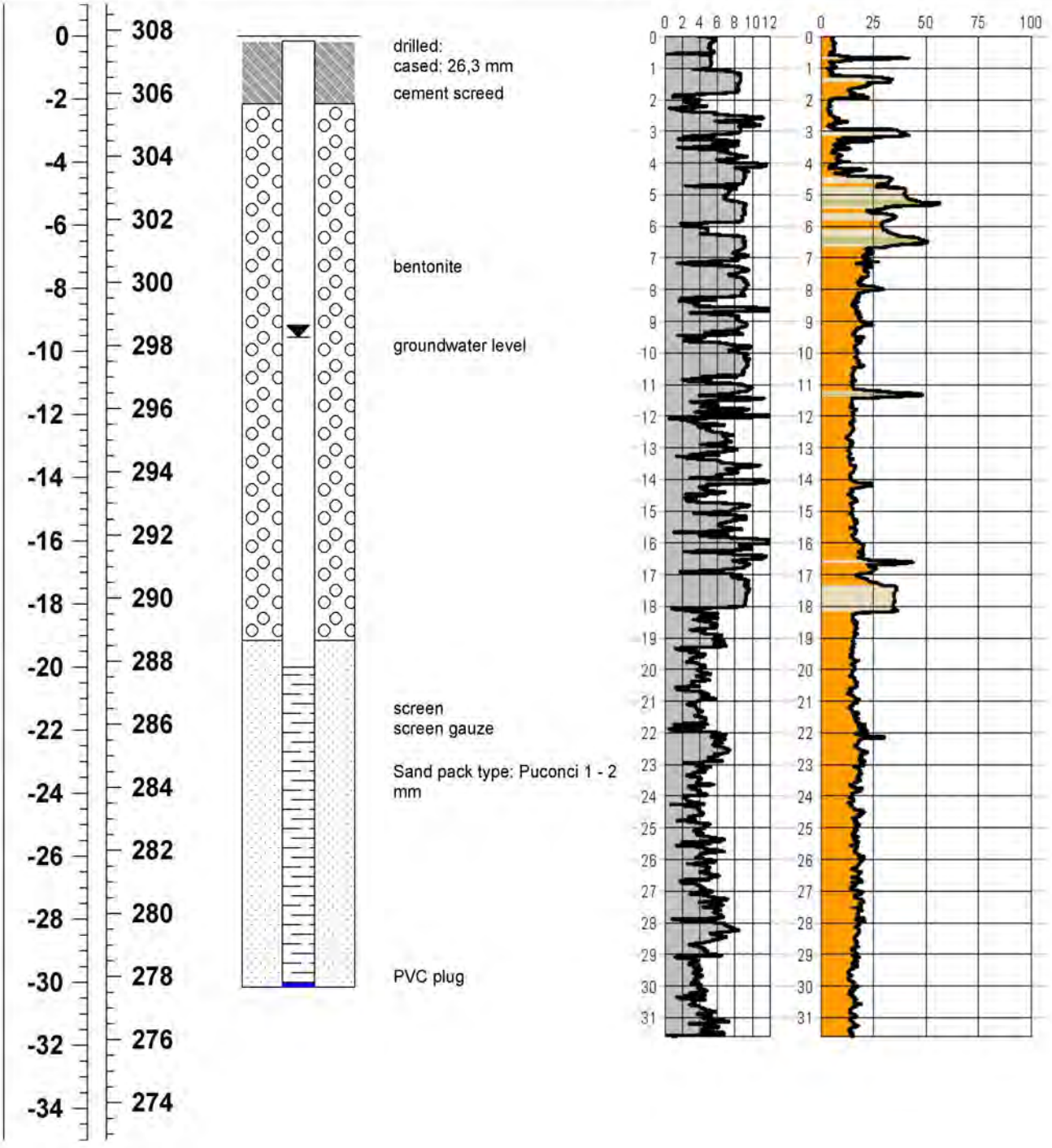
Object: **INC-33S**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **30**		

Electr. Conductivity (mS/m)	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable

Technical description of well

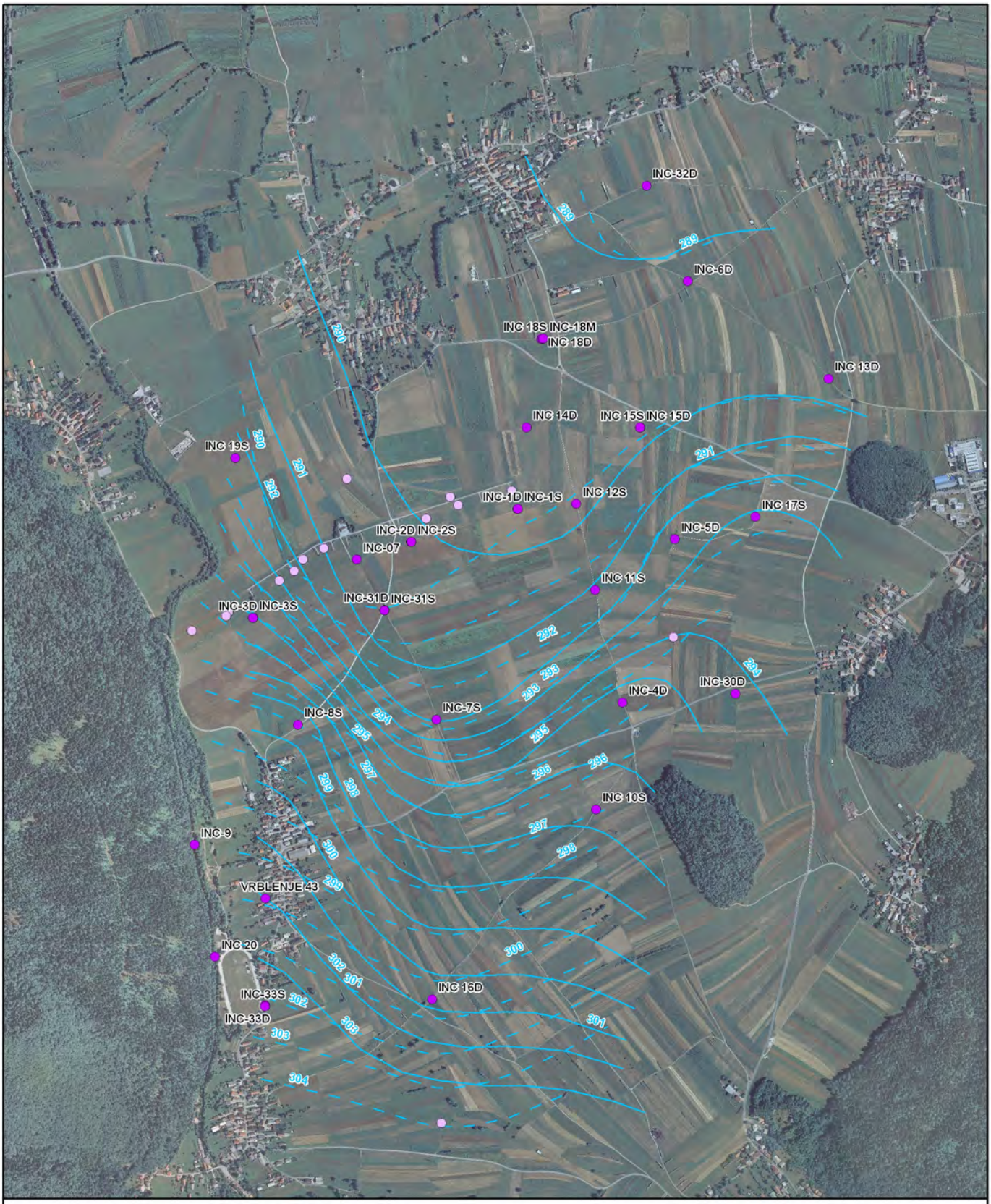
Name:	Well type:	Drill method:	Date:	GWLD:
INC-33D	**Observation well**	**Direct Push Method**	**27.10.2011**	**Z= 298,105**
Location: **Brest**	X=	Y=	Field altitude: **Z= 307,815**	Top of Casing altitude: Z=

Depth	Altitude	Well construction	Speed (m/min)	Electrical Conductivity (mS/cm)



Object: **INC-33D**	Contractor:	Legend:
Claimer:	**Geo-Log, GmbH; University of Göttingen**	
Scale (vertical):	Processed: **Meglič P., Šram D.**	
Appendix: **31**		

Electr. Conductivity [mS/m]	Interpretation
0 - 30	GRAVEL - SAND
30 - 45	SAND, silty
45 - 60	SAND, very silty
60 - 80	SILT
80 - 200	SILT - CLAY
> 200	not interpretable



Map of groundwater levels

Legend

- Observation well (INCOME)
- Well / Observation well (VO-KA)
- 300 Groundwater levels (Date 22.11.2011)
- 300 Groundwater levels (Date 4.11.2011)

INCOME Water Care

Geological Survey of Slovenia

N

0 0.25 0.5 1 km

Data source:
GURS, 2006; GeoZS & VO-KA, 2011.

Digital cartography:
Meglič P., Šram D.

Appendix 32