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Dudgeon Offshore Wind Farm

Stages 1 to 3 Geoarchaeological and Palaeoenvironmental Assessment

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geoservices

Dudgeon Offshore Wind Farm

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Summary

Wessex Archaeology was commissioned by Royal Haskoning DHV to undertake Stage 1 to 3 geoarchaeological and palaeoenvironmental assessment of borehole samples from the site of the proposed Dudgeon Offshore Windfarm.

The Stage 1 work comprised the assessment of 27 borehole logs and 32 CPT (Cone Penetrometer Test) logs. The Stage 2 work comprised the geoarchaeological recording and subsampling of 63 samples from 6 boreholes (**BH06**, **BH13**, **BH15**, **BH19A**, **BH21** and **BH25**). The following geological formations were interpreted from the Stage 1 and 2 work:

- Chalk Bedrock
- Swarte Bank Formation
- Egmond Ground Formation
- Bolders Bank Formation
- Holocene terrestrial sediments
- Seabed Sediment

The Pleistocene sediments including the Swarte Bank, Egmond Ground and Bolders Bank formation were identified as glacial and shallow marine deposits thought to have been deposited during the Lower and Middle Palaeolithic archaeological periods. The Holocene terrestrial sediments were subjected to Stage 3 palaeoenvironmental assessment with two boreholes **BH06** and **BH21** providing the focus for study. Assessment for pollen, diatoms, foraminifera, ostracods, plants and molluscs was undertaken in conjunction with radiocarbon dating revealing interesting freshwater and estuarine environments dating to the Mesolithic archaeological period. In addition, the dating suggests that sediments within borehole **BH06** might also relate to the Storegga slide tsunami which is thought to have affected Mesolithic communities in the North Sea area around 8100 years ago.

Stage 4 analysis of pollen, foraminifera, ostracods, plants and molluscs and further radiocarbon dating is recommended in particular to better understand the interesting sediments within borehole **BH06**.

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Stage 1 to 3 Geoarchaeological and Palaeoenvironmental Assessment

Acknowledgements

Wessex Archaeology is grateful to Royal Haskoning DHV. for commissioning the Stage 1 to 3 geoarchaeological and palaeoenvironmental assessment of CPT and borehole samples and in particular to Helen Craven (Royal Haskoning DHV) and Michael Corney (Statkraft) for their assistance. Thanks are also due to the geotechnical engineers from GEO and Callum Duffy for providing samples for this work.

The Stage 1 reviews of data were undertaken by Jack Russell. The Stage 2 geoarchaeological recording and subsampling was undertaken by Laura Andrews and Jack Russell. The Stage 3 palaeoenvironmental assessment, and processing of samples was undertaken by Rob Scaife (pollen and diatoms), John Whittaker (foraminifera and ostracods) and Sarah Wyles (molluscs and waterlogged plants). The radiocarbon dating was undertaken at the Scottish Universities Environmental Research Centre (SUERC), East Kilbride under the supervision of Gordon Cook.

This report was written by Jack Russell and figures were prepared by Ken Lymer. The project was managed for Wessex Archaeology by Jack Russell.

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Dudgeon Offshore Wind Farm

Stage 1 to 3 Geoarchaeological and Palaeoenvironmental Assessment

1 INTRODUCTION

1.1.1 Wessex Archaeology (WA) was commissioned by Royal Haskoning DHV Ltd. to undertake Stage 1 to 3 geoarchaeological and palaeoenvironmental assessment of Cone Penetrometer Test (CPT) and borehole data. The geotechnical investigations were undertaken during 2013 and 2014 (GEO 2014) on the site of the proposed Dudgeon Offshore Wind Farm hereafter "the site". The site is located approximately 32km north east of Cromer, off the north Norfolk coast (**Figure 1**).

1.1.2 This study forms part of an ongoing programme of geoarchaeological works for the proposed Dudgeon Offshore Wind Farm as detailed in two Written Schemes of Investigation (WSI) (WA 2013 and WA 2014.). CPT and borehole investigations provide an opportunity to review the geological sequence from a geoarchaeological perspective to help gauge the archaeological and palaeoenvironmental potential of the site, with regard to any possible evidence of prehistoric activity within and adjacent to the site.

1.1.3 To help frame geoarchaeological investigations of this nature, WA has developed a five stage approach, encompassing different levels of investigation appropriate to the results obtained, accompanied by formal reporting of the results at the level achieved. The stages are summarised below.

Stage 1: Review	Initial archaeological assessment of the logs generated by geotechnical contractors to establish the presence and location of sediment units with likely archaeological, palaeo-environmental and/or dating potential. Typically units of interest would be fine-grained sediments deposited in fluvial or estuarine environments, and sediments containing organic remains such as peat or other plant material.
Stage 2: Geoarchaeological recording	Each core containing sedimentary units identified as having geoarchaeological, palaeoenvironmental or dating potential will be split and recorded in detail. A sedimentary description for each of the units will be made, and those units of particular archaeological/palaeoenvironmental interest will be highlighted and a simple deposit model produced from the core logs. The Stage 2 and Stage 3 assessment can be conducted concurrently, whilst ensuring that the samples collected are treated in the appropriate way for archaeological study.

Stage 3: Assessment	Assessment of sub-samples taken from units of archaeological and/or palaeoenvironmental interest. The assessment of microfossil environmental indicators (pollen, diatoms, ostracods and/or foraminifera) will be taken, with the core retained should further sub-sampling be required. Assessment will comprise identification and quality of preservation of a series of subsamples to enable the value of the palaeoenvironmental material surviving within the cores to be identified. Subsamples may also be taken and submitted for scientific dating if required at this stage.
Stage 4: Analysis and Dating	Full analysis of pollen, diatoms and/or foraminifera assessed during Stage 3. Typically, Stage 4 will be supported by radiocarbon dating of suitable sub-samples. Should the Stage 3 assessment indicate that there is no further analytical work required on the microfossil assemblages, consideration will still be given for a programme of radiocarbon analyses to provide a chronological framework for the deposits encountered unless no suitable samples could be procured. The Stage 4 report will provide an account of the palaeoenvironment(s) at each relevant coring location within a chronological framework (absolute or relative) and an outline of the archaeological implications of the analysis.
Final Reporting and Publication	If the archaeological results are sufficiently significant as to warrant it, a Stage 5 report covering all aspects of palaeotopography and prehistory of the area affected by projects will be compiled after the last phase of analysis, and could be prepared as a publication, possibly in conjunction with BGS. If the archaeological results are less significant then the relevant Stage reports will constitute the final documents on the geotechnical work. If required, a Stage 5 report will include relevant data generated by other archaeological investigations on the site. It will, if warranted include a full assessment of the available seismic data, undertaken in order to place the results of the core recording and analysis within the context of the broad pattern of deposits within the area. The report will comprise as detailed a Quaternary deposit model for the area as possible, and address the implications of that model in terms of archaeological potential.

1.2 Aim and Objectives

1.2.1 The aim of the investigation proposed here is to make maximum archaeological use of the Dudgeon OWF geotechnical investigations. The objectives are as follows:

- To generate geoarchaeological data for archaeological assessment;
- To obtain where necessary sub-samples of sequences of archaeological interest that can be considered in decisions about palaeo-environmental assessment, analysis and scientific dating;
- To enhance the results of the geophysical assessment undertaken during the preparation of the Environmental Statement ES (WA 2009) and the ongoing geoarchaeological work;
- To mitigate the potential negative impacts of the construction of the scheme on archaeology and cultural heritage.

1.3 Geoarchaeological Background

1.3.1 The following background summarises the geological formations known to exist at the site. The age estimates are given related to the established British and Northwest European stage names. Within the Pleistocene epoch these are also supplemented,

where known, with the now more prevalent and comparable Marine Isotope Stages (MIS), where odd numbers indicate an interglacial period and even numbers a glacial period. Ages in years within the Pleistocene epoch are expressed in millions of years ago (MA), thousands of years ago (ka) and within the Holocene epoch as years before present (BP).

1.3.2 The British Geological Survey have mapped and described the geological formations in the area (Cook 1991, Brown 1986) and it is with reference to this framework that the sedimentary sequence is discussed. The bedrock geology beneath the area is predominantly Upper Cretaceous Chalk Bedrock. This is overlain by Pleistocene and Holocene deposits which have been interpreted predominantly from seismic surveys undertaken between 1968 and 1981. The formations have been cored in some areas of the North Sea where microfossil analyses and stratigraphic relationships have been used to determine the ages of the formations (Hopson *et al*. 1991).

1.3.3 Overlying Chalk bedrock in the area are three major Pleistocene formations of note; the Swarte Bank, the Egmond Ground formation and the Bolders Bank formation.

1.3.4 The Swarte Bank formation comprises the infill of sub glacial valley systems originally cut during the Anglian glaciation and infilled during the early part of the Wolstonian period (MIS 10 to 9; *c*.350 to 280ka). The basal sediments of the Swarte Bank formation comprise gravels, sands and stiff grey diamictons overlain by glaciolacustrine and glaciomarine sands and muds.

1.3.5 The Egmond Ground Formation is up to 16m in thickness and comprises sands and gravels thought to be marine in origin. The formation is thought to be Wolstonian age (MIS 8; *c*. 280 to 250Ka).

1.3.6 Across all of the site, the British Geological Survey has mapped of the Bolders Bank formation (Cook 1991, Brown 1986). This blanket of glacial till is extensive, overlying earlier Pleistocene formations and outcropping near the seabed surface. The formation comprises stiff red brown gravelly, sandy clays containing erratics including chalk, red-brown sandstone, grey mudstone and other metamorphic and igneous rocks. The formation is similar to the Hunstanton till of East Anglia and the tills of Holderness north of Spurn point. The formation is thought to be of late Devensian age (MIS 2; *c.* 18ka).

1.3.7 Whilst not mapped in the area by the British Geological Survey (Cook 1991, Brown 1986), incised into the Bolders Bank formation are known scaphiform glacial valleys which are in places infilled with the Botney Cut formation. These valleys are up to 60m in depth and 4km in width. The basal fill of the Botney Cut formation comprises red brown gravelly, sandy clays which are lithologically indistinct from the Bolders Bank formation (Cameron *et al*. 1992). The upper part of the Botney Cut formation comprises laminated sands and clays thought to have formed in glaciolacustrine and occasionally glaciomarine environments. The formation is thought to be of Devensian to possibly Early Holocene age (*c*. 18 to 12ka).

1.3.8 The Holocene terrestrial (fluvial, estuarine, lacustrine and coastal) environments and the probability that the areas have been inhabited have been inferred from the relatively shallow bathymetry and the finds made by fishermen of terrestrial sediments such as peat, terrestrial mammal bones and prehistoric archaeological finds across the Southern North Sea (e.g. Reid 1913, Godwin and Godwin 1933 and Coles 1998).

1.3.9 Whilst the exact geomorphology of the areas in the early Holocene, particularly the location and elevation of areas higher ground (which may have been subject to subsequent marine erosion) is unknown, it is possible to guess, based on current

bathymetry and with reference to known sea level curves (Shennan *et al*. 2000, 2002; Ward *et al*. 2006) when the area would have become submerged for the last time. It is likely that the site area would have become submerged for the last time by *c.*7000BP.

1.3.10 Recent seabed sediments are known across the site . These comprise sands and gravels and which are generally less that 2m in thickness where they are associated with the Bolders Bank formation (Cook 1991, Brown 1986).

2 METHODOLOGY

2.1 Stage 1 Review

2.1.1 The Stage 1 review comprised the assessment of 27 borehole logs from 26 locations generated by the Danish geotechnical company GEO during July and August 2013 the most recent versions of which (GEO 2014) are given in **Appendix 1**. In order to obtain maximum archaeological information from the survey this process was enhanced by a presentation, given by Jack Russell on 11th July aboard the MV *Blue Beta* whilst it was alongside in Great Yarmouth to explain fully the archaeological requirements. A list of potential locations and depths of interest was also compiled based on previous geophysical, geotechnical and archaeological surveys in the area.

2.1.2 A further 32 CPT logs generated during geotechnical survey by the MV *Blue Beta* during March 2014 were also reviewed in order to provide archaeological input into the limited sampling survey which was subsequently undertaken (**Appendix 2**).

2.1.3 Samples were retained for geoarchaeolgical recording in two forms. Firstly, sections of samples which were extruded on board the MV *Blue Beta* deemed worthy of further palaeoenvironmental work but not required for geotechnical work were retained in bags or "Waxed Quarts". A number of samples were also identified to be of geological and geoarchaeological importance and were retained intact within their steel shelby liners for on-shore extrusion and potential archaeological and palaeoenvironmental assessments.

2.2 Stage 2 Geoarchaeological recording and subsampling

2.2.1 The samples were transported to WA's environmental processing laboratory, where they were geoarchaeologically recorded. Each bagged sample was opened and core samples were split longitudinally, photographed and recorded. The descriptions (**Appendix 3**) provided details of the depth to each sediment horizon, the character and form of the sediment. Sedimentary characteristics recorded included texture, colour and depositional structure.

2.2.2 Subsamples were taken from relevant deposits in order to provide chronological and environmental information relating to their formation. The selections were made on the basis of the sediment identified from the geoarchaeological recording of the samples. Samples taken were targeted at sediments thought to be of potential geological, geoarchaeological and palaeoenvironmental interest. The positions and depths of the samples are shown on **Figures 2** to **3** and in the table below.

Borehole ID:	Sample depths (m below seabed)	Pollen	Diatoms	Forams	Ostracods	Plants	Molluscs	14C
BH02	15.35	y	y	y	y			
BH06	2.35	y	y	y	y	y	y	y
BH06	10.29	y	y	y	y	y	y	y
BH06	10.45	y	y	y	y	y	y	
BH06	11.72	y	y	y	y	y	y	
BH06	12	y	y	y	y	y	y	
BH06	12.15	y	y	y	y	y	y	
BH06	12.39	y	y	y	y	y	y	
BH06	12.53	y	y	y	y	y	y	
BH06	12.76	y	y	y	y	y	y	
BH06	13.25	y	y	y	y			
BH06	14	y	y	y	y	y	y	y
BH21	0.7	y	y	y	y	y	y	
BH21	1.97	y	y	y	y	y	y	
BH21	2.21	y	y	y	y	y	y	y
BH21	3.1	y	y	y	y	y	y	y
BH21	5.11	y	y	y	y			
BH21	10.81	y	y	y	y			

2.3 Stage 3 Palaeoenvironmental assessment and dating

2.3.1 Eighteen sediment samples from boreholes **BH02**, **BH06** and **BH21** of approximately 25cm^3 were taken for foraminifera, ostracod assessment. The samples were broken into small pieces by hand, placed in ceramic bowls, and dried in an oven. Boiling-hot water was then poured over them, with a little sodium carbonate added to help disaggregate the clay fraction. Each was left to soak overnight. Washing was with hand-hot water through a 75 micron sieve, the remaining residue being returned to the ceramic bowl for final drying in the oven. The samples were then stored in labelled plastic bags. For examination, each sample was placed in a nest of sieves (>50, >250, >150 microns, and base pan) and thoroughly shaken. A little of each grade was then sprinkled onto a picking tray and viewed under a binocular microscope. “Organic Remains” from the three boreholes were logged on a presence/absence basis. Identification follows Murray (2006) for the foraminifera, and Athersuch, Horne & Whittaker (1989) and Meisch (2000) for the brackish/marine and freshwater ostracods, respectively.

2.3.2 Eighteen sediment samples from boreholes **BH02**, **BH06** and **BH21** of approximately 4cm^3 were taken for pollen and diatom assessment. These were taken to the University of Southampton for preparation.

2.3.3 Pollen sub-samples of 2cm^3 were processed using standard techniques for the extraction of the sub-fossil pollen and spores (Moore and Webb 1978; Moore *et al.* 1992). Micromesh sieving (10micron) was also used to aid with removal of the clay fraction from these largely minerogenic sediments. The pollen and spores were identified and counted

using an Olympus biological research microscope fitted with Leitz optics. A pollen sum of up to 150 grains per sample level was counted where preservation allowed. Other, miscellaneous microfossils including substantial numbers of algal *Pediastrum* and pre-Quaternary palynomorphs were also recorded. Data, where appropriate are presented in pollen diagram form (**Figures 4** and **5**). The former have been plotted using Tilia and Tilia Graph.

2.3.4 Diatom preparation followed standard techniques: the oxidation of organic sediment, removal of carbonate and clay, concentration of diatom valves and washing with distilled water. Two coverslips, each of a different concentration of the cleaned solution, were prepared from each sample and fixed in Naphrax, a mounting medium of a suitable refractive index for diatom microscopy. Slides were scanned at magnifications of x400 and x1000 under phase contrast.

2.3.5 Fourteen samples from two boreholes **BH06** and **BH21** assessed of the recovery, survival and potential of waterlogged plant remains and molluscs. The samples were processed by wet-sieving using a 0.25mm mesh size. The samples were visually inspected under a x10 to x40 stereo-binocular microscope to determine if waterlogged plant remains and molluscs were preserved. Nomenclature for waterlogged plant remains follows that of Stace (1997). Nomenclature and habitat preferences of molluscs follows that of Anderson (2005), Kerney (1999) and Barrett and Yonge (1958).

2.3.6 Four samples were taken for radiocarbon dating. Two from borehole **BH06**, and two from borehole **BH21**. Radiocarbon dating samples were selected from the samples that had been processed for foraminifera, ostracods, waterlogged plant and molluscs assessment. Suitable material was identified under a microscope and stored in glass tubes and proloc bags for delivery to the Radiocarbon Dating Facility at the Scottish Universities Environmental Research Centre (SUERC), East Kilbride, Scotland (**Appendix 1).** Due to the failure of one sample from borehole **BH06** at 14.00m below Seabed a second sample from 2.35m below Seabed was submitted.

3 RESULTS

3.1 Stage 1 Review

3.1.1 Stage 1 review of borehole logs in 2013 resulted in 63 samples from 6 boreholes (**BH06**, **BH13**, **BH15**, **BH19A**, **BH21** and **BH25**) being retained specifically for archaeological purposes by the geotechnical contractors and sent to Wessex Archaeology, with a particular emphasis on the Holocene sequences identified in borehole **BH06** and **BH21**.

3.1.2 The subsequent 2014 Stage 1 review of the 32 CPT logs indicated any borehole sampling at these locations was less likely to produce samples and stratigraphic sequences of greater interest and quality than those already recovered during the 2013 campaign. Nevertheless, the geotechnical engineers were instructed to retain any samples which could relate to former palaeolandscapes of interest and two small samples from locations CPT 30 (at 14.5m below Seabed and CPT 31 at 5.55m below Seabed) were retained within “Waxed Quarts” by the geotechnical engineers as potentially interesting. These have not yet been opened.

3.2 Stage 2 Geoarchaeological recording and subsampling

3.2.1 The results of the Stage 2 geoarchaeological recording of the 63 samples from 8 boreholes are given in **Appendix 3** and summarised below.

3.2.2 Four samples from borehole **BH02** were geoarchaeologically recorded (**Appendix 3**). The sample of grey chalky clay from 15.35 to 15.42m was retained due to organic inclusions noted by the geotechnical engineers (**Appendix 1**) in an otherwise minerogenic glacial till like deposit of the Swarte Bank formation. Above this some bagged samples of mixed gravelly, shelly and organic sand thought to relate to the shallow marine deposits of the Egmond Ground formation were recorded.

3.2.3 Four samples from borehole **BH03** were geoarchaeologically recorded (**Appendix 3**) between 1.4 and 4.0m of the Seabed. The recorded sequence shows organic clays and sands of the Holocene organic alluvial sediments (2.65 to 4m) overlain by more recent marine shelly and sandy seabed sediments recorded in the samples at 1.4 to 2.20m below seabed.

3.2.4 One sample from **BH04** at 13.20m below Seabed was geoarchaeologically recorded (**Appendix 3**). The sample contained gravelly shelly sand thought to relate to the shallow marine deposits of the Egmond Ground formation.

3.2.5 Twenty five samples from borehole **BH06** between 2.35 and 19.35m below Seabed were geoarchaeologically recorded (**Appendix 3**)**.** The samples from 12.82 to 19.35m below seabed contained fine grained organic sediments overlain by peat deposits from 10.22m to 12.82m. The horizontal bedding of both deposits and mollusc inclusions were indicative of potentially tidally induced deposition. From 2.35 to 10.22m below the Seabed a thick layer of mixed gravelly, shelly sand was recorded of much higher energy and rapid marine deposition was recorded. The uppermost sample at 2.35m contained a peaty silty deposit indicative of a return to lower energy nearshore and terrestrial depositional environments.

3.2.6 One sample from **BH13** at 11.00m below Seabed was geoarchaeologically recorded (**Appendix 3**). The sample contained shelly silty sand which probably relate to the shallow marine deposits of the Egmond Ground formation.

3.2.7 One sample from **BH15** at 8.50m below Seabed was geoarchaeologically recorded (**Appendix 3**). The sample contained gravelly shelly silty sand possibly relating to the shallow marine deposits of the Egmond Ground formation.

3.2.8 One sample from **BH19A** at 0.35m below Seabed was geoarchaeologically recorded (**Appendix 3**). The sample contained gravelly clayey shelly silty sand which was possibly taken from the interface between the Bolders Bank glacial Till and overlying seabed sediments.

3.2.9 Twenty one samples from borehole **BH21** taken between 0.00 and 11.75m below Seabed were geoarchaeologically recorded (**Appendix 3**)**.** The samples recorded between 5.00 and 11.75m below Seabed of laminated silts and sands appear marine/estuarine in origin and notably greyer and less organic than the overlying sediments. The samples from 0.00 to 5.00m below Seabed were similar shallow marine/estuarine alluvial interbedded silts and sands but more organic with frequent molluscan inclusions.

3.2.10 Three samples from borehole **BH25** were geoarchaeologically recorded (**Appendix 3**) between 2.6 and 12.65m below Seabed. The samples contained stiff sands and clays though to be glacial tills of the Bolders Bank formation.

3.2.11 Subamples suitable for scientific dating (**BH06** and **BH21**) and palaeoenvironmental assessment (**BH02**, **BH06** and **BH21**) were taken. Two boreholes, **BH06** and **BH21** penetrated particularly interesting depositional sequences which were subsampled extensively.

3.3 Stage 3 Palaeoenvironmental Assessment and dating

3.3.1 The subsampled levels from boreholes **BH06** and **BH21** which are shown in relation to the geotechnical borehole logs on **Figures 2** and **3** gave generally positive results from a palaeoenvironmental perspective although diatoms were notably largely absent from the sediments. The singular sediment subsample from borehole **BH02**, was however largely barren of palaeoenvironmental remains.

Pollen

3.3.2 Pollen was recovered from the samples in boreholes **BH06** and **BH21** and was absent from the singular sample from borehole **BH02** at 15.35m below Seabed.

3.3.3 Pollen was well preserved within boreholes **BH06** and **BH21** and pollen profiles have been created (**Figures 4** and **5**). Each profile has been divided into two local pollen assemblage zones (l.p.a.z) based on the observed taxonomic changes which are described below: Within borehole **BH06** pollen was absent in the basal sample at 13.25m. The profile spanning *c.* 2metres of organic and mineral sediment is divided into two distinct local pollen assemblage zones and are shown on **Figure 4** and summarised in the table below:

l.p.a.z	***Palynological character***
1.) Zone BH06: 2 11.45m to 10.30m *Corylus avellana* type-*Quercus*	This lower zone boundary is delimited by a sharp change at 11.45m with *Betula*, *Pinus*, Poaceae and *Pediastrum* declining to low levels. In contrast, *Corylus avellana* type becomes dominant (to 90%) with *Quercus* (to 25%). *Pinus* (5%), *Ulmus* (2-3%) remain with sporadic occurrences of *Alnus* and *Salix*. Herbs comprise low levels of Poaceae and Chenopodiaceae. Spores comprise monolete *Dryopteris* type and occasional *Polypodium*.
2.) Zone BH06: 1 12.40m to 11.45m *Betula-Corylus avellana* type-Poaceae-*Pediastrum*	Herbs are more important in this zone than in zone 2 above. *Betula* is the dominant tree peaking to 68% at the top of the zone. *Corylus avellana* type peaks at 12.0m (to 60%) then declines. *Pinus* also increases to 15%. There are sporadic *Ulmus, Quercus* and *Salix*. *Juniperus* is present in the basal sample only. Herbs are important with Poaceae dominant (55%) declining from highest numbers in the basal sample. Other herbs include *Artemisia* at the base (5%) and a more diverse range in the basal level. Marsh and aquatic taxa comprise high levels of *Pediastrum* (76% sum + Misc.) and Cyperaceae (12%) also in the basal sample.

3.3.4 Interpretation of the profile can be considered in terms of contribution of the on-site and off-site vegetation to the pollen spectra. Here, the former shows a strong freshwater habitat especially at the base of the profile where cysts of freshwater algal *Pediastrum* are important. This phase corresponds with the late-Devensian or early Holocene transition period. Aquatic conditions remained with aquatic macrophytes present (water milfoil) and marginal fen plants (sedges, reedmace and/or bur reed, water plantain and likely some of the grasses).

3.3.5 The terrestrial flora shows the near site dominance of birch woodland which became more important. This is the early Holocene (Flandrian Ia; Pre-Boreal) expansion of this pioneer tree after temperature rise at *c.* 10,000BP, the close of the Devensian.

3.3.6 Further evidence of the Devensian-Holocene is present in the lowest sample. Here, the herb numbers and diversity is greater than above and represents the remains of the more heliophilous flora of the late glacial (Younger *Dryas*; Zone III). Grass communities, rock rose (*Helianthemum*) and mugwort (*Artemisia*) are diagnostic.

3.3.7 Juniper (*Juniperus*) is also present in the basal level and typically represents the Devensian/Holocene transition. This was followed by the expansion to dominance of birch woodland. This was followed by pine and hazel during the Boreal period the Boreal pine-hazel woodland described by Godwin (1956, 1975) and the incoming of oak and elm into the region. The changing woodland elements, seen in this profile illustrate the dynamic biogeography of the pre-Boreal and early Boreal periods (Flandrian chronozones Ia-b) as trees migrated from their glacial refugia. Subsequently, in l.p.a.z. 2, birch woodland was replaced by more competitive woodland with hazel fully established and dominant along with expanding oak and elm woodland.

3.3.8 Because of the dominance of trees and shrubs, there are few herbs. Where these occur they are the autochthonous marsh elements. There are also traces of Chenopodiaceae (goosefoot, oraches and samphire) which are likely to derive from salt marsh, halophytic communities developing ahead of marine transgression.

3.3.9 Within borehole **BH21** two local pollen zones were recognised (**Figure 5**) which are summarised in the table below:

l.p.a.z	***Palynological character***
3.) Zone BH21: 2 2.60m to 0.79m *Pinus-Ulmus-Quercus-Corylus avellana* type	*Corylus avellana* type peaks at 2.20m (68%) followed by expansion of *Pinus* (20%), *Quercus* (20%) and *Ulmus* (15%). There are sporadic occurrences of *Tilia* and *Alnus.* There are few herbs compared with zone 1 with only small numbers of Chenopodiaceae and Poaceae. Marsh/aquatic comprise Cyperaceae (4%) and small numbers of *Typha angustifolia* type. *Pediastrum* is present.
4.) Zone BH21: 1 3.20m to 2.60m Poaceae-*Dryopteris* type	Arboreal pollen and shrub pollen comprises 45% while herbs are 55% of the total pollen. Poaceae are dominant (to 48%) with few other herb taxa present apart from marsh taxa; Cyperaceae (7%). Trees and shrubs comprise *Betula* (11%), *Quercus* (5%), *Corylus avellana* type (25%) and *Salix*. *Dryopteris* type (monolete form) spores are abundant (36%). *Pediastrum* (6%) is present

3.3.10 Overall, the taxonomic diversity is low with a range of tree and shrub types but few herbs. L.p.a.z. 1 contrast with zone 2 being dominated by grasses (Poaceae) and ferns (*Dryopteris* types). This may reflect deposition in a freshwater alluvial habitat as indicated by freshwater *Pediastrum* (algum) which is more abundant than in the subsequent zone. During this phase, the arboreal flora also differs with more important birch along with some oak, pine and hazel. Percentages of these may be low being suppressed by the high values of grass pollen which is also calculated within the pollen sum.

3.3.11 Subsequently, in l.p.a.z. 2, hazel became dominant also with significant expansions of pine, elm and oak. These assemblages are typical of the Boreal (Flandrian I b-c). There are also traces of alder and lime in this zone which, although probably not present on the site at this time, are a portent of the vegetation which would subsequently become

important in its migration across the North Sea Basin and become the established woodland of the mainland.

3.3.12 There are few herbs. Chenopodiaceae are, however, present in small numbers and, as with borehole **BH06**: 2, may indicate the inception of saline conditions and development of salt marsh within the region prior to marine transgression

Diatoms

3.3.13 Eighteen samples were assessed from boreholes **BH02**, **BH06** and **BH21**. Diatoms were, unfortunately almost absent in the samples. Detailed examination of the slides revealed only 3 tiny and unidentifiable fragments of diatom frustule.

Microfauna (Foraminifera and Ostracods)

3.3.14 The results of the microfaunal assessment are shown in tabular form in **Appendix 4**, colour-coding being employed to indicate the ecological preferences of the foraminiferal and ostracod species listed. These are based to a large extent on Murray (2006) for the foraminifera, and Athersuch, Horne & Whittaker (1989) and Meisch (2000) for the brackish/marine and freshwater ostracods, respectively.

3.3.15 The singular sample from borehole **BH02** at 15.35m below Seabed was barren other than many reworked Cretaceous microfossils.

3.3.16 In borehole **BH06** eleven samples were examined covering the interval 2.35 down to 14.10m below Seabed (**Appendix 4**). The lowest two samples are barren, save for plant remains and much reworked Cretaceous microfossils (especially fossil foraminifera). The next 5 samples although covering a rather short interval (12.00-12.76m below Seabed) are certainly interesting. They contain a rich freshwater ostracod fauna of 7 species in total, by far the most common being *Cytherissa lacustris*, most of them preserved as carapaces and thus *in situ.* This species likes/prefers cool/cold deep water in rivers and lakes (Meisch, 2000). The other species suggest a weedy spring-fed freshwater body, indicative more of shallows. The lowest sample in this interval and the top two also contain an estuarine component. Perhaps this was washed in initially and latterly, until the site became fully estuarine. At 11.72m below Seabed the freshwater component suddenly disappears and by 10.29m below Seabed a sizeable marine component characterises the ecology, much of it clinging (foraminifera) on sea-grass or phytal (ostracods) on marine-algae, as sea-level rose still further and a large open estuary/gulf developed.

3.3.17 Six samples were assessed from borehole **BH21**, covering the interval 0.7m down to 10.81m below Seabed. The lowest two samples (5.11-10.81m below LAT) are very fine brown silts containing a few marine foraminifera many reworked Cretaceous microfossils. The faunas are unusual and may possibly relate to a Pleistocene marine interglacial. The subsequent part of the sedimentary sequence from 3.10m below Seabed and above, is more straightforward, but unlike **BH06**, there is no freshwater component whatsoever. Foraminifera and ostracods occur in large numbers and indicate the presence of tidal mudflats and creeks. On the evidence of the ostracod *Cyprideis torosa* - at first noded then smooth - this was initially low brackish. Associated marine components then serve to indicate more open estuarine conditions prevailed, with finally, near-marine salinities and the presence of much sea-grass and marine-algae.

Other organic remains

3.3.18 Fish remains were found in several samples in borehole **BH06** (**Appendix 4**), but none occurred in borehole **BH21**. In the samples from borehole **BH06** between 10.29 and 12.39m below Seabed (**Appendix 4**) were cyprinid teeth (freshwater fish of the carp

family which can also tolerate low salinities in estuaries). In addition other fish remains were noted within 10.45 and 12.39m below Seabed in borehole **BH06** mostly comprising fish scales and also a fish vertebra from the sample at 12.76m below Seabed.

3.3.19 Charcoal was also recovered from borehole **BH06** at 2.35m and within borehole **BH21** at 5.11 and 10.81m below Seabed small pieces of probable charcoal were recorded (**Appendix 4**).

Waterlogged plant and mollusc assessment

3.3.20 Molluscs were recorded in eight of the 10 samples from borehole **BH06** and waterlogged plants from four of the samples. The abundance of waterlogged plants and molluscs within the samples from borehole **BH06** is shown in the table below.

Depth (m) below seabed	**2.35**	**10.29**	**10.45**	**11.72**	**12**	**12.15**	**12.39**	**12.53**	**12.76**	**14**
Terrestrial mollusc species										
Zonitoides nitidus	-	A	-	-	-	-	-	-	-	-
Freshwater mollusc species										
Valvata piscinalis	-	-	-	-	-	-	-	B	-	-
Planorbids	-	C	-	-	-	-	-	-	-	-
Pisidium sp.	-	-	-	-	-	C	-	A	-	-
Brackish water/marine mollusc species										
Ecrobia ventrosa	-	C	C	-	C	C	-	-	-	-
Peringia ulvae	C	C	C	-	-	-	-	-	-	-
Ecrobia/Peringia	-	C	C	C	-	-	-	-	-	-
Tellina/Scrobic.type	C	-	-	-	-	-	-	-	C	-
Cardium	C	C	C	+	-	+	-	-	C	-
Mytilus edulis	-	-	-	+	-	-	-	-	-	-
Rissoidae	C	A	C	C	-	C	-	-	B	-
Littorina	C	C	-	-	-	-	-	-	-	-
Buccinum	-	-	-	+	-	C	-	-	-	-
Other										
worm casts	-	A	-	-	-	-	-	-	-	-
Waterlogged plants										
?Alisma	-	1	-	-	-	-	-	-	-	-
Potamogeton	-	-	-	-	-	1	2	-	-	5
Carex (triangular)	-	-	-	-	-	2	1	-	-	-

Key: A* = 30+, A = >10, B = 9-5, C = <5; + = present

3.3.21 Molluscs recorded included terrestrial, freshwater and brackish water/marine species, in varying quantities. The small assemblages from 2.35m, 10.45m, 11.72m and 12.00m below Seabed were comprised of the brackish-water/marine species. These included shells of cockle (*Cardium* sp.), mussel (*Mytilus edulis*), periwinkle (*Littorina* sp.), whelk (*Buccinum* sp.), tellin/furrow shell (Tellina/Scrobicularia type), spire shells (*Ecrobia ventrosa*) and laver spire shells (*Peringia ulvae*). These may be reflective of a more open estuarine environment.

3.3.22 The larger assemblage from 10.29m below Seabed however contained a similar brackish-water/marine element to that observed in the samples discussed above but there was also a freshwater component represented by planorbids and a significant terrestrial element formed by *Zonitoides nitidus*. 'This is a characteristic wetland species. A typical habitat is the zone of emergent vegetation at the edges of lakes and rivers, where it lives on decaying *Phragmites* or *Carex* litter, or on driftwood or other flotsam lying in muddy ground' (Kerney 1999).

3.3.23 Both brackish-water/marine and freshwater species were recovered in the small assemblage from 12.15m. These included *Pisidium* sp., spire shells, cockle shell, rissoides and whelks. This may be indicative of an open estuary with freshwater input. The moderate assemblage observed in the sample from 12.53m comprised freshwater species. These included shells of *Valvata piscinalis* and *Pisidium* sp. This assemblage is indicative of a freshwater environment of moving water. In contrast only brackish-water/marine shells were recorded in the sample from 12.76m below Seabed. These included shells of tellin/furrow shells, cockles and rissoides.

3.3.24 Only very small numbers of waterlogged plant remains were recorded in four of the samples from borehole **BH06**, at 10.29m, 12.15m, 12.39m and 14.00m below Seabed. These included seeds of water-plantain (*Alisma* sp.), pondweed (*Potamogeton* sp.) and sedge (*Carex* sp.).

3.3.25 No waterlogged plant remains were recovered in the four samples from borehole **BH21.** Molluscs were present in all four samples from borehole **BH21** generally in moderately high numbers and are shown in the table below.

Depth below seabed	**0.70m**	**1.97m**	**2.21m**	**3.10m**
Terrestrial mollusc species				
Zonitoides nitidus	-	A	B	-
Freshwater mollusc species				
Valvata cristata	-	A	B	C
Brackish water /marine mollusc species				
Ecrobia ventrosa	B	-	A	A
Peringia ulvae	B	-	A	C
Ecrobia/Peringia	A	C	A	B
Tellina/Scrobicularia type	-	C	-	-
Cardium	C	-	A	A
Mytilus edulis	-	+	-	-
Rissoidae	A	A	-	C
Littorina	C	A	C	C
Balanus	+	-	-	-
Other				
?Spirorbis worm casts	A	A	-	-

Key: A* = 30+, A = >10, B = 9-5, C = <5; + = present

3.3.26 The sample from 0.70m below Seabed contained brackish-water/marine shells, including those of spire shells, laver spire shells, cockles, rissoides, periwinkles and barnacles (*Balanus* sp.). This assemblage appears to be indicative of an open estuary environment.

3.3.27 The assemblages from the samples from 1.97m and 2.21m below Seabed included specimens of the terrestrial species *Zonitoides nitidus* and the freshwater species *Valvata cristata* as well as brackish-water/marine species similar to those seen in the sample described above. The assemblage recovered from 3.10m below Seabed comprised shells of brackish-water/marine species and *Valvata cristata*. These assemblages appear to be indicative of an open estuary environment possibly with mudflats.

Radiocarbon dating

3.3.28 Five samples were submitted for radiocarbon dating. Five seeds of *Potomageton* (pondweed) were submitted from borehole **BH06** retrieved from the sample at 14.00m

below seabed. The sample failed due to insufficient carbon being present within the material.

3.3.29 The other four samples, two from borehole **BH06** and two from borehole **BH21** were successful with the raw, calibrated and plotted results shown in **Appendix 5**. The dates were calibrated against the Marine13 radiocarbon curve (Reimer *et al*. 2013) using the program OxCal 4.1.7 (Bronk Ramsey 2010) and using a delta –R value of zero.

3.3.30 Within borehole **BH06** at 10.29m below Seabed a marine shell (*Littorina*) returned a date of 8324±32BP SUERC-51293 (7046-6810cal. BC; 8996-8760cal. BP) equivalent to the Early Mesolithic archaeological period. Above this at 2.35m below Seabed at a marine shell (*Cerastoderma*) returned a date of 7549±31BP SUERC-52113 (6155-5981cal. BC; 8105-7931cal. BP) equivalent to the Late Mesolithic archaeological period.

3.3.31 Within borehole **BH21** at 3.10m below Seabed a marine shell (*Cerastoderma*) returned a date of 8398±32BP SUERC-51294 (7158-6497cal.BC; 9108-8447cal. BP) which spans the Early and Late Mesolithic archaeological periods. Above this at 2.21m below Seabed at a marine shell (*Cerastoderma*) returned a date of 8295±32BP SUERC-51295 (7028-6768cal. BC; 8978-8718cal. BP) equivalent to the Early Mesolithic archaeological period.

4 DISCUSSION

4.1.1 The geological sequence penetrated by the assessed boreholes comprised Chalk Bedrock overlain by Pleistocene (Swarte Bank, Egmond Ground the Bolders Bank) and Holocene (organic and alluvial channel sequences) and more recent seabed sediment.

4.1.2 Clearly the Chalk Bedrock is too old to be of archaeological interest and was not assessed in this study, however it's surface may mark/form the extent of palaeogeographic of archaeological interest. The overlying Swarte Bank formation identified within the boreholes was assessed within the sample at 15.35m below Seabed in borehole **BH02** but yielded little of interest (save some reworked microfossils from the underlying Chalk). The subsampled sediment was from a chalky glacial till which contained some occasional large organic inclusions. The British Geological Survey suggest a Wolstonian age for the formation (MIS 10 *c*. 350ka to MIS 9 *c.* 280ka) (Cameron *et al.* 1992). Whilst this age spans the Lower to Middle Palaeolithic archaeological transition a known period of occupation of the British Isles it is unlikely that any archaeological and/or palaeoenvironmental remains will be found in glacial sediments of this type.

4.1.3 The Egmond Ground formation, interpreted from the geoarchaeological recording within boreholes **BH02**, **BH04**, **BH13** and **BH14** comprising shallow marine deposits is thought to have been deposited during the Wolstonian period (MIS 8; *c*. 280 to 250ka). A number of archaeological sites dated to MIS 8 and 7 and containing Early Middle Palaeolithic assemblages are located in Suffolk and along the present-day Thames River (White *et al.* 2006) are known. It is also worth noting that 100km southeast of the site, the aggregate extraction area known as Area 240 has yielded a large number of artefacts including 33 hand axes and 100 fragments of faunal remains including woolly mammoth, woolly rhino, bison, reindeer and horse. The handaxes are datable by typology to the Middle Palaeolithic archaeological period (*c*. 300 to 30ka) thus proving the potential for Middle Palaeolithic archaeological remains to occur within sediments of the Southern North Sea (WA 2010b). The sediments assessed here however are marine in origin and therefore of low archaeological/palaeoenvironmental potential.

4.1.4 The extensive Bolders Bank Devensian glacial till formation geoarchaeologically recorded within samples from borehole **BH25** was not subjected to any palaeoenvironmental assessment as it is unlikely to contain any palaeoenvironmental remains of interest and is thought to date to the late Devensian (MIS 2; *c.* 18ka) a period of non-occupation of the British Isles.

4.1.5 The most interesting sediments from an archaeological and geoarchaeological perspective were the Holocene sediments identified within boreholes **BH06** and **BH21**. Both boreholes are located within a northwest to southeast delineated channel-like feature identified within sub bottom geophysical data (Wessex Archaeology 2009) (**Figure 1**). It is possible that this feature is a Devensian glacial feature cut during the glacial retreat equivalent to the Botney Cut formation. Within borehole **BH06** the palaeoenvironmental assessment indicates that in the early Holocene a freshwater lake developed within the feature. This was surrounded by a birch and juniper dominated woodland with some hazel also. The Holocene sea level rise is then recorded within the peat and minerogenic sediments in both boreholes **BH06** and **BH21,** where a brackish estuarine environment existed at both locations dated to the lower Mesolithic archaeological period *c.*9000 to 8500BP. At this time the palaeoenvironmental remains indicate a tidal environment of brackish creeks surrounded by fen, marshland and hazel dominated woodland.

4.1.6 A most interesting 7.5m thick (from 2.8 to 10.22 m below Seabed) high energy deposit of gravel and sand lies immediately above the early Mesolithic peat in borehole **BH06** (**Figure 2**) was recorded. Above this at 2.35m a brief return to more sedate brackish estuarine depositional conditions was recorded and dated to 8105-7931cal.BP equivalent to the late Mesolithic archaeological period. There is a major Holocene geological "event" of note known as the 'Storegga slide', a tsunami event created by a huge submarine landslide which is thought to have occurred at *c*.8100 BP (Bondevik *et al*. 1997, Weninger *et al*. 2008). It is possible that the 7.5m thick gravel and sand deposit may relate to this event. This event is thought to have had major implications for Mesolithic communities in the North Sea area and is thus of great archaeological interest. It is interesting to note however that the only sample from borehole **BH06** that contained charcoal was at 2.35m which is potentially indicative of human occupation at this time and dated to a period immediately after the Storegga slide.

4.1.7 A large amount of literature regarding the possibility of Mesolithic occupation in the North Sea has been produced (e.g. Reid 1913, Coles 1998, Flemming 2004 and Waddington 2007). It should be mentioned that no finds of this date have been recovered from within the site but the terrestrial environments and features identified during this study and within the geophysical data (Wessex Archaeology 2009) could contain Mesolithic archaeological remains.

5 RECOMMENDATIONS

5.1.1 It is recommended that Stage 4 analyses of pollen, plants, molluscs, ostracods and foraminifera can be undertaken on the sequences from the assessed samples. The best sequence is from borehole **BH06** where further samples from closer intervals to investigate some of the interesting lacustrine sediments and the subsequent marine and potential tsunami sediments is recommended. Additional radiocarbon dating of the freshwater sequence within borehole **BH06** is also recommended.

5.1.2 Two samples from the most recent geotechnical survey have been retained for study and these should be recorded. The integration of these results with the sub bottom geophysical data and the ongoing geotechnical work into a deposit model is also recommended – and to include modelling of the Pleistocene and Holocene sediments. The final output of a Stage 4 analysis report will form the basis of a publication in a relevant journal.

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7 APPENDIX 1: BOREHOLE LOGS

BH Log: ST13467-BH01

Coordinates (m): E: 391,116.9 N: 5,900,276 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Seabed Level (m): -23.8

Notes:

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Dry rotary drilling	1-D	0	1.3D	0.20				*Loose, brown, gravelly, medium - coarse, calcareous SAND, Gravel is subrounded, w. several shell fragments.*	Seabed					
	1-TW		1.1D		0.7	-24.5		0.30 becoming sl. clayey	BB up					
	2-TW	1	1.2D 1.3D 2.1U	1.00-1.50				*Stiff, brown, sl. sandy, gravelly, calcareous CLAY. Gravel is subangular to subrounded*						
	3-TW 4-B	2	3.1D 3.2D 3.3D 3.4D	2.10										
	5-TW	3	5.1U	3.00-3.65				3.00 becoming firm to stiff						
	6-TW	4	6.1U	4.00-4.70	4.5	-28.3		*Firm, brown, sl. sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, w. lime grains*	BB mi				1.89	1.63
	7-D 7-TW	5	7.1D	5.50										
	8-TW	6	7.2D 7.3D 7.4D 7.5U 8.1U	5.65-5.90 6.00-6.90										
	9-TW	7	9.1U	7.00-7.65										
	10-TW	8	10.1D 10.2D 10.3D 10.5D	8.20 8.50-8.70									1.87	1.64
	11-C 11-D	9	10.4U		9.2	-33.0		*Firm, brown, sl. sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, w. lime grains*	BB lo	100				
		10	11.1D 11.2D 11.3D 11.5D	9.80 10.10-10.40									2.14	1.83
	12-C		11.1D 11.4U							17				
	13-C	12								75				
	14-C	13	14.1D 14.2D 14.3D 14.4D 14.5U	13.10 13.25-13.50						50			2.23	1.92
	15-C	14								50				
	16-C									40				
	17-C	15	17.1D 17.2D 17.3D 17.4D 17.5U	15.00 15.10-15.25	15.0	-38.8		*Firm, brown, sl. sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, w. lime grains*	CB-cl	70			2.24	1.93
	18-C	16								30				
	19-C				16.7	-40.5				70				
	20-C 20-D	17	20.4U	17.20-17.45				*Firm, light grey, sandy, gravelly, very calcareous CLAY. Gravel is fine to coarse and subangular to subrounded, and consists mainly of chalk*	SB	65			2.16	1.83
			20.1D 20.2D 20.3D	17.60										
	21-C	18	20.5D 20.1D	18.10-18.25						56				
	22-C		21.1U 22.1U	18.55-18.75 18.75-18.95						100			2.18	1.84
	23-C	19	22.2U 23.5U 23.6U 23.4U	19.05-19.30 19.30-19.55 19.55-19.80	19.0	-42.8		*Stiff to very stiff, light grey, sandy, very gravelly, very calcareous CLAY. Gravel is fine to coarse and subangular to subrounded and consists mainly of chalk*	SB	95				
	24-C	20	23.1D 23.2D 23.3D	19.90						87			2.04	1.74
		21												
	25-C 25-D	22	25.1D 25.2D 25.3D 25.1D 25.4U	21.60 21.80-22.10						100			2.13	1.83
	26-C	23						23.30 - 23.50 w. several white, low density chalk parts 23.50 w. several parts of grey clay parts		97				
		24	26.1U 26.2U 26.3U	23.60-23.90 23.90-24.20 24.30-24.45				24.00 - 24.15 w. fine grey clay laminae					2.24	1.97
	27-C	25						25.30 w. parts of grey clay		100				
	28-C	26	28.1U 28.2U	26.10-26.30 26.30-26.55	26.0	-49.8		*Very stiff to hard, light grey, sandy, gravelly, very calcareous CLAY. Gravel is fine to coarse and subangular to subrounded* 26.60 - 26.90 weak, low density, white, structureless chalk. Matrix composed of uncompact muddy chalk and clay	SB	93			2.16	2.00
		27	28.3U	26.90-27.15				27.15 - 27.20 weak, low density, white, structureless chalk. Matrix composed of uncompact muddy chalk and clay						
	29-C 29-D	28	29.1D 29.2D 29.3D 29.4D 29.1D	27.80						97				
	30-C	29								97				

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

PCPT Tip Resistance (MPa) 2 4 6 8 — 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

1136

1033

Borehole Log: ST13467-BH01	Drilled:	ELF/BSM	Date:	2013-06-19	Report No.: 1.1
Project: 36685 Dudgeon	Prepared:	KRA/LFJ	Date:	2013-06-21	Encl No.: 1.1D.ST13467-BH01
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked:	ABP/NKA	Date:	2014-01-28	Rev : 1
	Approved:	CLB	Date:	2014-01-28	Page: 1 / 2

W W W . G E O . D K

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:35

BH Log: ST13467-BH01

Coordinates (m): E: 391,116.9 N: 5,900,276 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -23.8

Geobor-S *(continued)*

Lab specimen No. and type	Lab specimen Depth	Boundary Depth (m)	Boundary Elevation (m)	Description of *layers* and details	Formation	TCR (%)	SCR (%)	RQD (%)	Density Bulk (Mg/m³)	Density Dry (Mg/m³)
				Very stiff to hard, light grey, sandy, gravelly, very calcareous CLAY. Gravel is fine to coarse and subangular to subrounded (continued)	SB					
31-C						100				
31.1U	30.50-30.80									
31.2U	30.80-31.10									
		32.2	-56.0							
32-C	32.20-32.45			*Very stiff to hard, grey, very sandy, gravelly, calcareous CLAY. Gravel is fine to coarse and subangular to subrounded*	SB	100			2.17	1.86
32.1U										
32-D	32.45-32.70									
32.2U										
32.3U	32.70-32.95								2.34	2.14
32.4D	33.10									
32.5D										
32.6D										
32.4D										
33-C						69				
		34.6	-58.4							
		35.1	-58.9	*SAND (according to drilling leader)*	Lag					
				Very weak, low density, white, structureless CHALK. Matrix composed of uncompact muddy chalk. Clasts are of very weak, low density, white chalk. (CIRIA Dm, low density)	Chalk	40	0	0		
34-C										
35-C						80	0	0		
36-C				37.00 w. 55 x 70 mm black flint nodule 37.30 w. few 10 - 30 mm black flint nodules		70	0	0		
		38.0	-61.8							
37-C				*Very weak to weak, low density, white, structureless CHALK, very closely to closely spaced, *closed or clean fractures. (CIRIA A3/A4, low density)* 38.10 - 38.60 w. vertical fissure 38.80 - 38.90 w. black flint layer	Chalk	67	47	23		
38-C						100				
39-C				41.00 - 41.30 white chalk, structureless 41.70 w. 50 mm grey ash layer		100	53	0		
39.1D	42.00									
40-C	40.1U 42.50-42.70					100	81	33		
				43.00 - 43.25 w. light grey patches 43.40 w. 10 mm black flint layer						
40.2D	43.50									
41-C						100				
		45.5	-69.3							
42-C				*Weak, low density, white, CHALK, extremely to closely spaced, *closed or clean fractures. (CIRIA A3/A5, low density)* 45.60 w. 50 x 60 mm black flint nodule 45.95 - 46.10 w. vertical fissure 46.40 w. 30 x 40 mm black flint nodule 47.05 w. several 1 - 2 mm marl flasers 47.20 - 48.00 w. several light grey patches	Chalk	67	27	0		
42.1D	45.70									
42.2D	46.00									
43-C						100	70	50		
43.1D	47.95									
44-C						100	40	20		
45-C				48.40 - 48.58 w. black flint layer		80				
		50.0	-73.8							

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

PCPT Tip Resistance (MPa) 2 4 6 8 — 20 40 60 80

Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH01	Drilled: ELF/BSM	Date: 2013-06-19	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared: KRA/LFJ	Date: 2013-06-21	Encl No.: 1.1D.ST13467-BH01	
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved: CLB	Date: 2014-01-28	Page: 2 / 2	

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:35

BH Log: ST13467-BH02

Coordinates (m): E: 389,662 N: 5,902,582.1 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.6

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Bailer	1-LB	0	1.1D	0.30	0.2	-20.7		*Very loose, dark greyish brown, very gravelly, calcareous, medium to coarse SAND. Gravel is rounded to subangular, rich in shells and shell fragments*	Seabed / BB up					
	2-TW	1	1.2D 1.3D 2.1U	1.00-1.40				*Stiff, dark greyish brown, sandy, gravelly, calcareous CLAY. Gravel is fine to coarse, subrounded to subangular, mainly limestone grains*						
	3-TW	2	3.1U	2.00-2.30										
	4-TW	3	4.1U	3.10-3.40	3.2	-23.8			BB mi				2.23	1.93
			4.2U	3.40-3.60				*Stiff, dark greyish brown, sandy, gravelly, calcareous CLAY. Gravel is fine to coarse, subrounded to subangular, mainly limestone grains*						
		4	4.3D 4.4D 4.5D	3.70										
	5-TW		5.1U	4.55-4.75									2.15	1.85
		5	5.2D 5.3D	5.00										
	6-TW		5.4D 6.1U	5.50-6.25				5.50 - 6.50 very stiff, silty clay						
		6			6.0	-26.6		*Stiff, dark greyish brown, sandy, gravelly, calcareous CLAY. Gravel is fine to coarse, subrounded to subangular, mainly limestone grains*	BB lo					
	7-TW	7	7.1U	6.50-7.20										
	8-TW		8.1U	7.65-7.85									2.18	1.87
		8	8.2D 8.3D 8.4D	8.00										
	9-TW		9.1U	8.60-8.85									2.23	2.04
		9	9.2D 9.3D 9.4D	9.10										
	10-TW		10.1D	9.65	9.7	-30.2								
	11-LB	10	11.1D	9.80	9.8	-30.4		*Dense to very dense, greyish brown, sl. silty, sl. gravelly, calcareous, fine to medium SAND. Gravel is fine and subangular to subrounded*	EG / EG					
	12-LB		12.1D	10.80				*Dense to very dense, greyish brown, sl. gravelly, sl. calcareous, fine to medium SAND. Gravel is fine to medium and subangular to subrounded, w. shell fragments, w. silty and clayey laminae and streaks* 11.30 - 11.35 w. 50 mm dark grey, sandy, gravelly gyttja layer, w. many shaly pieces (char coal?)						
	13-LB	11	13.1D 13.2D	11.30 11.35										
	14-B													
	15-LB	12	15.1D 15.2D	12.30	12.3	-32.9			EG					
	16-B	13						*Dense to very dense, grey, calcareous, fine to medium SAND, w. few coarse particles* 12.80 - 13.80 very gravelly, w. many shells and shell fragments						
	17-LB				13.9	-34.5								
		14	17.1D 17.2D 17.3D	14.00				*Stiff to very stiff, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, w. many chalk fragments*	SB					
Geobor-S	18-C	15	18.1U	14.80-16.30						100				
		16						16.15 - 16.25 very high chalk content		100			2.33	2.05
	19-C		19.1U 19.2U	16.50-16.75 16.75-17.00										
		17	19.3U 19.4D 19.5D 19.6D	17.00-17.25 17.30				17.55 - 18.40 very high chalk content						
	20-C	18	20.1U	18.40-18.65						79			2.14	1.84
	21-C	19	21.1U	19.20-20.70						100				
		20						19.95 100 mm layer w. very high chalk content						
	22-C		22.1U	20.80-21.05				20.70 becoming hard to very hard		100	0	0	2.29	2.00
		21	22.2D 22.3U 22.4D 22.5D 22.6U	21.05 21.15-21.40 21.40 21.75-22.00										
					22.1	-42.6								
	23-C	22						*Very weak, low density, white CHALK. Matrix composed of sl. muddy, uncompacted chalk, w. marl and clay streaks. Clasts are very weak, low density, white chalk (CIRIA Dm, low density)*	Chalk	67	0	0		
		23			23.2	-43.8			Chalk					
	24-C		24.1D	23.80				*Very weak to weak, low density, white CHALK, extremely closely to closely spaced, closed or clean fractures, w. few 1-2 mm marl flasers, w. few dark grey flint nodules (CIRIA A5-A3, low density)*		100	100	13	1.93	1.48
		24	24.2D 24.3D 24.4D 24.5D 24.6D	24.80										
	25-C	25						25.45 50 mm dark grey flint layer		85	81	15		
	26-C	26	25.1D 25.2D 25.2D	26.10 26.40				26.50 - 27.90 w. very few dark grey flint nodules 26.70 50 mm grey marl layer 27.30 - 27.75 w. many 10-20 mm light grey, silicified burrows		93	93	0	1.95	1.52
		27												
	27-C	28	27.1D 27.2D	28.05	28.0	-48.6		*Very weak to weak, low density, white CHALK, closely spaced, closed or clean fractures, w. few burrows (CIRIA A3, low density)* 28.75 60 mm dark grey flint layer	Chalk	87	87	30	1.96	1.53
	28-C	29								100	57	23		

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

PCPT Tip Resistance (MPa) 2 4 6 8 / 20 40 60 80

Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH02	Drilled: KEJ/KHH	Date: 2013-07-05	Report No.: 1.1
Project: 36685 Dudgeon	Prepared: LTR/STK	Date: 2013-07-05	Encl No.: 1.1D.ST13467-BH02
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1
	Approved: CLB	Date: 2014-01-28	Page: 1 / 2

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:37

BH Log: ST13467-BH02

Coordinates (m): E: 389,662 N: 5,902,582.1 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.6

Geology

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Geobor-S (continued)		30						*Very weak to weak, low density, white CHALK, closely spaced, closed or clean fractures, w. few burrows (CIRIA A3, low density) (continued)*	Chalk					
			28.1U	30.60-30.85									1.91	1.47
	29-C	31						30.25 6 mm grey marl seam 30.45 60 mm dark grey flint layer 31.45 - 31.60 w. diagonal fracture		90	47	37		
		32			32.5	-53.1								
	30-C		30.1U	32.70-32.90				*Very weak to weak, low density, white CHALK, closely to medium spaced, closed or clean fractures, w. burrows, w. several 1-2 mm marl flasers (CIRIA A2/A3, low density)*	Chalk	97	73	53		
		33	30.1U 30.2D 30.3D 30.4D 30.5D	33.20 33.40									1.88	1.42
	31-C	34						32.60 50 mm dark grey flint nodule 33.10 10 mm grey marl seam		90	67	53		
		35	31.1U	35.00-35.20									1.90	1.45
					35.5	-56.1								
	32-C	36						*Very weak to weak, low density, white CHALK, extremely close to close spaced, closed or clean fractures, w. burrows (CIRIA A3/A5, low density)*	Chalk	93	30	17		
					37.0	-57.6		35.50 - 36.10 w. many grey specks 36.40 70 mm dark grey flint layer						
	33-C	37	33.1U	37.05-37.25				*Very weak to weak, low density, white CHALK, closely to medium spaced, closed or clean fractures, w. a few burrows (CIRIA A2/A3, low density)*	Chalk	97	77	53	1.93	1.45
		38			38.5	-59.1								
	34-C	39	34.1D 34.2D	39.40				*Very weak to weak, low density, white CHALK, closely spaced, closed or clean fractures, w. a few burrows (CIRIA A3, low density)*	Chalk	93	37	20	1.96	1.53
	35-C	40						40.00 - 41.35 closely to medium (CIRIA A2/A3, low density)		90	53	50		
		41						41.15 50 mm dark grey flint layer						
	36-C		36.1U	41.70-41.90						87	53	40	1.87	1.41
		42						41.95 50 mm dark grey flint nodule						
	37-C	43						43.00 120 mm dark grey flint layer		100	47	33		
			37.2D	43.50										
		44	37.1D	44.20				44.00 - 44.20 w. several diagonal fractures					1.91	1.45
	38-C									100	40	33		
		45						45.20 - 45.50 w. diagonal fracture						
			38.1D 38.2D	45.70				45.60 w. glauconite					1.93	1.49
					46.0	-66.6								
	39-C	46	39.1U	46.10-46.35				*Very weak to weak, low density, white CHALK, widely spaced, closed or clean fractures, w. burrows (CIRIA A1, low density)*	Chalk	87	77	67	1.97	1.52
		47	39.2D 39.3D 39.4D 39.5D	47.15										
					47.5	-68.1								
	40-C	48	40.1D 40.2D	47.90				*Very weak to weak, low density, white CHALK, closely spaced, closed or clean fractures, w. several 1-2 mm marl flasers (CIRIA A3, low density)*	Chalk	100	57	20		
	41-C	49						49.05 30 mm dark grey flint layer		3	0	0		
		50												
					50.5	-71.1								

Undrained shear strength
— N_k=12 } Est. from CPT
— N_k=18 }
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8
PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH02	Drilled: KEJ/KHH	Date: 2013-07-05	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: LTR/STK	Date: 2013-07-05	Encl No.: 1.1D.ST13467-BH02		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 2 / 2		

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:37

BH Log: ST13467-BH03

Coordinates (m): E: 394,293 N: 5,903,441 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -22.3

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L
10 20 30 40 %

2 4 6 8 PCPT Tip Resistance (MPa)
20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Dry rotary drilling	1-TW	0	1.1D 1.2D 1.3D	0.20				*Loose-medium dense, brown, gravelly, calcareous,medium-corse SAND. Gravel is fine to corse and subrounded*	Seabed					
	2-LB	1	2.1D 2.2D 2.3D	1.40	1.0	-23.3		*Loose-medium dense, olivebrown, gravelly, calcareous,medium-corse SAND. Gravel is fine to medium and subangular to subrounded, w. shell fragments, m. char coal pieces, m. fine plant remains* 1.00 - 1.15 very gravelly	Seabed					
	3-LB	2	3.1D 3.2D	2.20	2.7	-25.0								
			3.3D	2.80	3.0	-25.3		*Plastic, very dark grey, amorpheus organic CLAY, w. odour*	Channel					
	4-TW	3	4.1D 4.2D 4.3D 4.4D	3.20 3.40					Channel					
					4.0	-26.3		*Very loose, greyish brown, sl. clayey, calcareous, fine SAND. w. fine char coal pieces* 3.10 - 3.25 very soft, silty, calcareous CLAY						
	5-TW	4	5.1U	4.00-4.85				*Soft to firm, brown, sl. sandy, sl. gravelly, calcareous CLAY. Gravel is fine and subrounded, w. lime grains*	BB up					
	6-TW	5	6.1U	5.00-5.50										
	7-TW	6	7.4U	6.20-6.40				6.00 becomming firm and gravel is fine to medium					1.97	1.53
			7.1D 7.2D 7.3D	6.50	7.0	-29.3		6.70 - 6.80 w. several very gravelly sand parts						
	8-TW	7	8.1U	7.00-7.50				*Very weak, low density, white, structureless CHALK. Matrix composed of uncompact muddy chalk. Clasts are very weak to weak, low density and white* *(CIRIA Dm, low density)* 8.00 becomming white to light gray	Chalk					
	9-TW 10-B	8												
	11-TW	9	11.1U	9.00-9.55										
	12-TW	10	12.1U	10.00-10.50										
					11.0	-33.3								
	13-TW	11	13.1U	11.00-11.65				*Very weak, low density, white, structureless CHALK. Matrix composed of uncompact muddy chalk. Clasts are very weak, low density white* *(CIRIA Dm, low density)*	Chalk					
	14-TW	12	14.1U	12.00-12.70										
					13.0	-35.3		12.70 w. grey marl parts						
Geobor-S	15-TW 16-C	13						*Very weak, low density, white CHALK, extremely to very closely spaced, closed or clean fractures* *(CIRIA A4/A5)* 13.00 w. 5mm grey marl seam	Chalk	80	0	0		
		14			14.5	-36.8		14.00 - 14.20 low density, white structureless chalk						
	17-C	15	17.1D	14.60				*Very weak, low density, white CHALK, very closely spaced, closed or clean fractures* *(CIRIA A4, low density)*	Chalk	53	33	0		
	18-C	16	18.1D	16.60				16.25 w. a 2 mm thick marl seam		85	40	0		
	19-C	17	19.1D	17.00						60	20	0		
					18.0	-40.3								
	20-C	18	20.1D	18.00				*Very weak to weak, low density, white CHALK, closely to medium spaced, closed or clean fractures* *(CIRIA A2/A3, low density)*	Chalk	75	65	45		
	21-C	19								75	50	42		
	22-C	20	22.1D 22.2D	20.20 20.30						87	87	57		
	23-C	21	23.1D	21.10						93	60	20		
		22												
	24-C	23	24.1D	22.60				23.45 w. 40-50 mm gray marl seam		90	90	63		
	25-C	24	25.1D	24.10						100	54	54		
		25												
	26-C	26								93	87	67		
	27-C	27	27.1D 27.2D 27.3D 27.4D 27.5U	27.50 27.50-27.70				27.35 w. 5 mm marl seam		90	83	77		
		28												
	28-C	29	28.1U	28.50-28.80						90	90	77		

Borehole Log: ST13467-BH03	Drilled: ELF/BSM	Date: 2013-06-20	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared: KRA/LFJ	Date: 2013-06-22	Encl No.: 1.1D.ST13467-BH03	
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved: CLB	Date: 2014-01-28	Page: 1 / 2	

GEO W W W . G E O . D K

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:40

BH Log: ST13467-BH03

Coordinates (m): E: 394,293 N: 5,903,441 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -22.3

Boundary (m)

Geology

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary: Depth	Boundary: Elevation	Graphic Log	Description of *layers* and details	Formation	TCR (%)	SCR (%)	RQD (%)	Bulk	Dry
Geobor-S *(continued)*	29-C	30	29.1D	29.90				*Very weak to weak, low density, white CHALK, closely to medium spaced, closed or clean fractures (CIRIA A2/A3, low density) (continued)*	Chalk	100	87	80		
		31						31.20 w. some grey marl seam						
	30-C	32	30.1U	32.00-32.20						100	100	93		
	31-C	33	31.1U	33.20-33.45				32.80 w. 80 mm grey marl seam		93	93	93		
		34												
	32-C	35	32.1U	35.35-35.55						93	93	93		
	33-C	36	33.1D 33.2D	36.40						93	73	73		
		37												
	34-C	38	34.1U	38.45-38.65						97	97	77		
	35-C	39	35.1D 35.2D 35.3D	39.00				39.65 w. some grey marl seam		83	70	20		
		40												
	36-C	41								100	67	13		
	37-C	42	37.1D	42.00						73	20	20		
		43												
	38-C	44	38.1U	44.30-44.60						93	87	67		
	39-C	45								100				
	40-C	46	40.1U	46.00-46.20						97	90	33		
		47												
	41-C	48	41.1U	47.70-47.90				48.30 w. 50x60 mm grey flint nodule		97	97	77		
		49			49.8	-72.0								

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

w_P w w_L
10 20 30 40 %

PCPT Tip Resistance (MPa)
2 4 6 8
20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

GEO WWW.GEO.DK	Borehole Log: ST13467-BH03	Drilled: ELF/BSM	Date: 2013-06-20	Report No.: 1.1	
	Project: 36685 Dudgeon	Prepared: KRA/LFJ	Date: 2013-06-22	Encl No.: 1.1D.ST13467-BH03	
	Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
		Approved: CLB	Date: 2014-01-28	Page: 2 / 2	

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:40

BH Log: ST13467-BH04

Coordinates (m): E: 388,036 N: 5,902,767 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -19.6

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Bailer	1-TW	0	1.1D	0.30	0.1	-19.6		*Very loose, multicoloured, sandy, calcareous, fine to coarse GRAVEL. Gravel is subrounded, w. shells and shell fragments*	Seabed					
			1.2D						BB up					
			1.3D											
			1.4D											
	2-B	1	2.1D	1.50				*Stiff, dark greyish brown, sandy, gravelly, calcareous CLAY. Gravel is fine to coarse subrounded to subangular, mainly limestone grains*						
			2.2D											
			2.3D											
	3-TW	2	2.4D	2.00-2.65										
			3.1U											
	4-TW	3	4.1U	3.00-3.45										
	5-TW	4	5.1D	4.25									2.26	1.97
			5.2D											
			5.3D	4.55-4.75										
			5.4U		5.0	-24.6								
	6-TW	5	6.1U	5.20-5.40				*Stiff, dark greyish brown, sandy, gravelly, calcareous CLAY. Gravel is fine to coarse subrounded to subangular, mainly limestone grains*	BB lo				2.22	1.96
			6.2D	5.50										
			6.3D											
			6.4D											
	7-TW	6	6.5D	6.00-6.90										
			7.1U											
	8-TW	7	8.1U	7.00-7.65										
	9-TW	8	9.1D	8.20									2.17	1.96
			9.2D											
			9.3D	8.50-8.70										
			9.4U											
	10-TW	9	10.1D	9.30									2.14	1.88
			10.2D											
			10.3D	9.65-9.85										
			10.4U											
	11-TW	10	11.1U	10.00-10.90										
	12-TW	11	12.1U	11.00-11.35										
					11.4	-31.0								
	13-LB		13.1D	11.50				*Medium dense to dense, greyish brown, sl. silty, sl. gravelly, calcareous fine to medium SAND. Gravel is fine and subangular to subrounded, w. many clayey streaks, w. few shell fragments*	EG					
			13.2D		11.9	-31.4								
			13.3D	11.85					EG					
		12	13.4D											
			13.5D											
	14-LB		14.1D	12.50	12.5	-32.1			EG					
	15-LB	13	15.1D	13.00				*Dense to very dense, grey, sl. calcareous, fine to medium SAND, w. light grey patches, w. very few fine gravels*						
			15.2D	13.20										
			15.3D											
	16-LB		15.4D											
			15.5D	13.80										
		14	16.1D											
			16.2D											
	17-LB		17.1D	14.70				*Dense to very dense, grey to brownish grey, fine to medium SAND, w. shell fragments, w. very few fine gravels* 13.20 - 13.40 grey to dark grey, sl. organic, w. frew medium gravels 14.35 - 14.45 medium to coarse sand, light brownish grey 15.15 - 15.35 medium to coarse sand, w. many shell fragments 15.65 70 mm gravel						
			17.2D											
		15	17.3D											
			17.4D											
	18-LB				15.7	-35.3			CB-cl					
	19-B	16	19.1D	16.00-16.50										
Geobor-S	20-C		20.1U	16.50-18.00				*Very stiff, brown to dark grey, sl. laminated, sl. silty, calcareous CLAY, w. reddish brown smears and stains, w. few <1 mm silt laminae, w. 10 mm dark grey, sandy streaks, w. colour lamination* 17.75 - 18.00 laminated, w. many reddish brown stains, brown to grey, w. chalk gravels		100				
		17												
	21-C		21.1D	18.20	18.1	-37.7			SB	100				
			21.2D											
			21.3D											
			21.4D					*Very stiff, grey, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, gravel is mostly chalk, sl. colour lamination*						
		18												
	22-C		22.1U	19.50-21.00						100				
		19												
		20												
					21.0	-40.6								
	23-C		23.1D	21.10				*Hard, grey, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, gravel is mainly chalk*	SB	93			2.27	1.96
		21	23.2D											
			23.3D	21.50-21.75										
			23.4U	21.75-22.00										
			23.5U											
		22												
	24-C		24.1D	22.80				22.75 - 22.85 w. dark grey to light grey patches 23.30 - 23.50 w. many light grey patches		90				
		23	24.2D											
			24.3D											
			24.4D											
	25-C	24								83			2.22	1.92
			25.1U	24.60-24.85										
			25.2U	24.85-25.10										
		25												
	26-C									97			2.32	2.01
		26	26.1U	25.95-26.20										
			26.2U	26.20-26.45										
			26.4D	26.60										
			26.5D	26.70-26.95										
	27-C	27	26.6D					27.00 - 28.45 very calcareous CLAY		84			2.17	1.86
			26.3U											
		28	27.1D	28.05										
			27.2D											
			27.3D											
	28-C		27.4D							100				
		29												
			28.1D	29.50										
			28.2D											

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
◉ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

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Borehole Log: ST13467-BH04	Drilled: KEJ/KHH	Date: 2013-07-06	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: LTR/STK	Date: 2013-07-07	Encl No.: 1.1D.ST13467-BH04		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 1 / 2		

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 09:55

BH Log: ST13467-BH04

Coordinates (m): E: 388,036 N: 5,902,767 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -19.6

Boundary (m)

Undrained shear strength: N_k=12, N_k=18 } Est. from CPT; Pocket Pen, Tor Vane, Lab Vane, Fall Cone, Intact UU, UCS, Rem. Lab vane/Fall cone (200 400 600 800 kPa)

$CaCO_3$ (4 8 12 16 %); w_P w w_L (10 20 30 40 %)

PCPT Tip Resistance (MPa) (2 4 6 8 — 20 40 60 80); Point Load Strength $I_{s\,50}$ (0.1 0.2 0.3 0.4MPa); D_r (Baldi et al.) (30 60 90 120 %)

Other Tests: Grain size distribution, Gas test, Triax CID, Triax CAU, Permeability, Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Geobor-S (continued)	29-C	30	28.3D 28.4D					*Hard, grey, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, gravel is mainly chalk (continued)*	SB	100				
			29.1U 29.2U	30.70-30.95 30.95-31.20									2.52	2.14
		31												
	30-C		30.1U 30.2U 30.3U	31.70-31.95 31.95-32.20 32.20-32.45						97			2.33	1.96
		32												
			30.4D 30.5D 30.6D	32.65										
	31-C	33								97				
			31.1D 31.2D 31.3D 31.4D	33.70										
		34												
	32-C		32.1U 32.2U 32.3U 32.4U	34.70-34.95 34.95-35.20 35.20-35.45 35.45-35.70						100			2.25	1.92
		35												
			32.5D	35.90	36.1	-55.7								
	33-C	36	32.6D 32.7D	36.15-36.40				*Hard, grey, sl. sandy, gravelly, calcareous CLAY. Gravel is fine to coarse, subrounded to subangular, mainly limestone grains*	SB	100			2.30	1.97
			33.1U	36.60										
			33.2D 33.3D 33.4D											
		37												
	34-C									100				
		38												
	35-C	39	35.1U	39.20-40.40						100				
		40												
	36-C									100				
		41	36.1U	41.10-41.35									2.26	1.95
			36.2D 36.3D 36.4D	41.55										
	37-C	42								83				
		43												
	38-C		38.1U	43.75-44.00						100			2.40	2.09
		44	38.2U 38.3U 38.4U	44.00-44.25 44.25-44.50 44.50-44.75				43.90 turning light grey						
			38.5D 38.6D 38.7D	44.90										
	39-C	45								100				
		46			46.5	-66.0		45.95 - 46.05 w. several 1-2 mm dark grey clay and fine sand laminae 46.00 - 46.10 50 x 50 mm limestone gravel 46.35 50 x 40 mm dark grey flint nodule	SB				2.40	1.91
			39.1D	46.55										
	40-C		40.1U	46.60-46.85	47.0	-66.5			SB	100			2.11	1.61
		47						*Hard, dark grey, laminated, calcareous CLAY. Rich in silt and fine sand laminae*						
			40.2D 40.3D 40.4D	47.60				*Hard, light grey, sl. sandy, very gravelly, very calcareous CLAY. Gravel is coarse, subangular, mainly flint and limestone grains* 47.35 70 x 80 mm dark grey flint cobble 47.80 50 x 50 mm dark grey flint gravel 48.00 80 x 100 mm mm dark grey flint cobble 48.35 100 x 130 mm dark grey flint cobble 49.50 30 x 50 mm dark grey flint gravel 49.60 50 x 50 mm dark grey flint gravel 49.90 40 x 60 mm dark grey flint gravel						
	41-C	48	40.5D							94				
			41.1D	48.80									2.31	2.06
			41.2D 41.3D							100				
	42-C	49	41.4D	49.40										
			42.1D	49.60-49.85									2.42	2.17
			42.2D 42.3D 42.4D		50.0	-69.6								
		50												

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 09:55

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Borehole Log: ST13467-BH04	Drilled: KEJ/KHH	Date: 2013-07-06	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: LTR/STK	Date: 2013-07-07	Encl No.: 1.1D.ST13467-BH04		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 2 / 2		

BH Log: ST13467-BH05

Coordinates (m): E: 391,967 N: 5,900,712 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.9

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Bailer	1-TW	0	1.1D	0.10	0.4	-21.3		*Loose, brown, gravelly, calcareous, medium to coarse SAND. Gravel is fine to medium, w. several shell fragments*	Seabed					
			1.2D											
			1.3D	0.50					BB up					
			1.4U	0.60-0.80									2.14	1.84
	2-TW	1	2.1U	1.00-1.50				*Firm to very stiff, brown, sandy, gravelly, calcareous, CLAY. Gravel is fine to medium and subangular to subrounded*						
	3-TW	2	3.1U	2.00-2.50										
	4-TW	3	4.1D	3.10									2.13	1.87
			4.2D	3.20-3.40										
			4.3D	3.40-3.60										
			4.4U											
			4.5U											
	5-TW	4	5.1U	4.10-4.30									2.17	1.85
			5.2U	4.30-4.50										
	6-TW	5	6.1U	5.00-5.60										
	7-TW	6	7.1U	6.00-6.70										
	8-TW	7	8.1D	7.20										
			8.2D	7.40-7.60									2.12	1.80
			8.3D											
			8.4U											
	9-TW	8	9.1D	8.20										
			9.2D	8.50-8.70										
			9.3D											
			9.4U		9.0	-29.9							2.20	1.89
Geobor-S	C 10-TW	9	10.1U	9.00-9.90				*Firm to very stiff, brown, sandy, gravelly, calcareous, CLAY. Gravel is fine to medium and subangular to subrounded*	BB mi					
	11-C	10	11.1D	10.20						23				
					11.2	-32.1								
	12-C		12.1U	11.35-11.55				*Firm to very stiff, brown, sandy, gravelly, calcareous, CLAY. Gravel is fine to medium and subangular to subrounded*	BB lo	45				
			12.2D	11.55										
			12.3D											
		12	12.4D											
	13-C		13.1U	12.20-13.05						95				
		13			13.3	-34.2		12.90 - 13.05 Very gravelly, mostly limestone						
	14-C							*Very weak to weak, low density, white CHALK. Matrix composed of uncompacted muddy chalk. Clasts are very weak to weak, low density, white chalk. (CIRIA Dm, low density)*	Chalk	13				
		14												
	15-C		15.1U	14.70-15.65						95				
	16-C	16	16.1D	16.20						100				
			16.2D											
			16.3D											
			16.4D											
		17			17.2	-38.1								
	17-C							*Weak, low density, white CHALK, extremely closely to closely spaced, closed or clean fractures (CIRIA A5/A3, low density)* 18.30 - 18.60 w. infilled fractures (CIRIA B1)	Chalk	100	93	57		
		18												
	18-C									67	60	50		
		19	18.1D	19.00				18.95 50 mm flint layer 19.05 - 19.45 w. light grey burrows						
			18.2D											
			18.3D											
			18.4D											
			18.5D											
		20												
	19-C							20.40 - 20.50 w. flint nodules		80	80	60		
		21	19.1D	20.90										
			19.2D											
	20-C							21.40 - 21.50 w. flint nodules		64	64	36		
	21-C	22								70	20	0		
			21.1D	22.75										
			21.2D		23.1	-44.0								
	22-C	23						*Very weak to weak, white CHALK, extremely closely to closely spaced, closed og clean, w. some burrows, w. vertical fractures* 23.80 - 23.85 w. greyish marl layer	Chalk	100	87	67		
		24												
	23-C	25	23.2U	25.00-26.30						100	93	67		
			23.1D	25.40										
		26						26.00 - 26.40 w. greyish burrows						
	24-C									93	33	0		
		27												
			24.1D	27.60										
			24.2D											
	25-C	28	25.1U	28.10-28.90						90	90	80		
		29												
			25.2D	29.20										
	26-C							29.60 - 29.70 w. black flint nodules		93	93	33		

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

2 4 6 8 PCPT Tip Resistance (MPa)

20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH05	Drilled: KEJ/KHH	Date: 2013-07-14	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared: KRA/STK	Date: 2013-07-14	Encl No.: 1.1D.ST13467-BH05	
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved: CLB	Date: 2014-01-28	Page: 1 / 2	

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 09:59

BH Log: ST13467-BH05

Coordinates (m): E: 391,967 N: 5,900,712 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.9

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

w_P w w_L
10 20 30 40 %

2 4 6 8
PCPT Tip Resistance (MPa)
20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Geobor-S *(continued)*	27-C	30–32	27.1D 27.2D	32.00				*Very weak to weak, white CHALK, extremely closely to closely spaced, closed og clean, w. some burrows, w. vertical fractures (continued)*	Chalk	90	23	0		
								31.95 - 32.00 w. black flint layer						
	28-C	32–34			33.9	-54.8				100	97	47		
	29-C	34–35	29.1D 29.2D	35.00				*Very weak to weak, low density, white CHALK, extremely closely to very closely spaced, closed to clean, w. many marl flasers and seams, w. burrows, w. subvertical fractures (CIRIA A5/A4, low density)*	Chalk	90	87	7		
	30-C	35–36	30.1U	35.90-36.40				35.15 - 35.25 w. black flint nodules 35.90 - 36.10 very weak to weak, low density, greyish sandy CHALK, w. many burrows at bottom of layer		100	100	67		
	31-C	36–37	31.1U	36.90-37.50						100	100	60		
			31.2U	37.60-37.80										
	32-C	38–39	31.3D 31.4D 31.5D 31.6D	38.00						93	83	20		
	33-C	40–41						40.10 - 40.15 w. black flint nodules		87	20	0		
	34-C	41–42	33.1D 33.2D	41.10				41.50 - 41.60 w. black flint nodules		100	83	13		
	35-C	43–44	35.1U	43.00-44.10						97	93	73		
			35.2D 35.3D	44.20	44.4	-65.3								
	36-C	45–46						*Very weak to weak, low density, white CHALK, extremely closely to closely spaced, closed or clean, w. marl seams and flasers, w. greyish burrows (CIRIA A5/A3, low density)*	Chalk	100	47	0		
	37-C	46–47	36.1D 36.2D	45.70						97	87	27		
			37.1U	46.40-46.60										
			37.2D 37.3D 37.4D 37.5D	46.70										
	38-C	48–49						47.20 50 mm flint layer 47.45 - 47.55 100 mm flint layer 48.10 - 48.15 50 mm flint layer		100	93	10		
	39-C	49–50	38.1D 38.2D	48.90						100	67	27		
			39.1U	49.90-50.20										
					50.4	-71.3								

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 09:59

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Borehole Log: ST13467-BH05	Drilled:	KEJ/KHH	Date: 2013-07-14	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared:	KRA/STK	Date: 2013-07-14	Encl No.: 1.1D.ST13467-BH05	
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked:	ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved:	CLB	Date: 2014-01-28	Page: 2 / 2	

BH Log: ST13467-BH06

Coordinates (m): E: 388,191.4 N: 5,904,885 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -18.4

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Bailer	1-LB	0	1.1D 1.2D 1.3D 1.4D	0.20				*Very loose, greyish brown, very gravelly, calcareous, medium to coarse SAND. Gravel is fine and subrounded to rounded, w. many shell fragments* 0.80 becoming loose to medium dense	Seabed					
	2-LB	1	2.1D 2.2D 2.3D 2.4D	1.20										
	3-LB	2	3.1D 3.2D	2.00	2.4	-20.7								
			3.3D 3.4D 3.5D 3.6D	2.35	2.8	-21.2		*Very soft, dark grey, sl. sandy, silty, calcareous GYTTJA, w. black char coal laminae, w. plant remains, w. thin fine sand laminae. Sand is mostly fine*	Channel					
	4-LB	3							Channel					
			4.1D	3.90				*Very loose to loose, greyish brown, very gravelly, calcareous, medium to coarse SAND. Gravel is fine and subrounded to rounded, w. many shell fragments* 4.40 - 4.50 sl. sandy, dense gravel layer, w. many shell fragments						
	5-LB	4	5.1D 5.2D 5.3D	4.00 4.60	4.5	-22.9			Channel					
			5.4D 5.5D 5.6D 6.1D	5.00										
			6.2D	5.60	6.0	-24.4		*Medium dense, brownish grey, very gravelly, calcareous fine to coarse SAND. Gravel is fine to medium and subrounded to rounded, w. many shell fragments* 5.40 - 5.55 sl. gravelly sand, w. char coal pieces and plant remains, sl. laminated	Channel					
	6-LB	5												
	7-LB	6	7.1D 7.2D 7.3D 7.4D	6.10				*Medium dense, grey, gravelly, calcareous fine to coarse SAND. Gravel is mostly fine and subrounded to rounded, w. shell fragments*						
	8-LB	7	8.1D	7.10										
			8.2D	7.60										
	9-LB	8	9.1D 9.2D 9.3D 9.4D	8.10 8.40										
	10-LB	9	10.1D	9.00-9.80										
	10a-B		10.2D	9.80-10.00										
	11-TW	10	10.3D 11.1U	10.00-10.60	10.3	-28.7		9.80 - 10.00 very soft to soft, grey, sandy, sl. calcareous GYTTJA, w. shell fratments	Channel					
					10.9	-29.3		*Very stiff, dark greyish brown, laminated, carbonate free, highly compacted, sl. sandy PEAT. Sand is fine to medium, w. <1 mm sand and sandy laminae*	Channel					
	12-TW	11	12.1D 12.2D	11.10 11.40	11.4	-29.8		*Very loose, dark brownish grey, laminated, sl. calcareous, organic, fine to medium SAND. w. peat fragments, w. plant remains*	Channel					
			12.3D 12.4D	11.50-11.70	11.9	-30.3		*Very stiff, dark greyish brown, laminated, carbonate free, highly compacted, sl. sandy PEAT. Sand is fine to medium, w. <1 mm sand and sandy laminae*	Channel					
	13-TW	12	12.5D 12.6U 13.1U	12.00-12.85										
	14-TW	13	14.1U	13.10-13.30	13.4	-31.8		*Very soft, grey to dark grey, highly laminated, sandy, calcareous GYTTJA, w. black highly organic laminae*	Channel					
			14.2D 14.3D	13.30 13.45										
			14.4D 14.5D	13.65-13.85				*Firm, greyish brown, laminated, calcareous, sl. clayey, very sandy SILT, w. fine sand laminae* 14.45 - 14.50 fine to medium sand						
	15-TW	14	15.1U	14.00-14.90	15.0	-33.4								
		15			15.5	-33.8			Channel					
	16-LB		16.1D 16.2D 16.3D 16.4D	15.30 15.60	16.0	-34.4		*Medium dense, brownish grey, sl. organic, gravelly, calcareous, fine to coarse SAND. Gravel is fine and subangular to subrounded, w. many shell fragments*	Channel					
		16	16.5D					*Medium dense, greyish brown, laminated, very silty, sl. gravelly, calcareous SAND. Gravel is fine and subangular to subrounded*	Channel					
	17-LB		17.1D 17.2D 17.3D	16.50										
		17	17.4D											
	18-LB		18.1D 18.2D 18.3D 18.4D	17.30				*Medium dense, brownish grey, sl. laminated, sl. silty, calcareous, fine to medium SAND, w. few gravels, w. silty to very silty laminae*						
		18	18.5D		18.3	-36.6								
	19-TW		19.1D 19.2D	18.30				*Very stiff, greyish brown, thinly laminated, very sandy, sl. clayey, calcareous SILT, w. many fine and laminae*	Channel					
			19.3D 19.4D 19.5U	18.70-18.90										
	20-TW	19	20.1U	19.20-19.65	19.5	-37.9								
	21-LB				19.8	-38.2		*Very stiff, greyish brown, sandy, gravelly, calcareous CLAY. Gravel is subrounded to subangular, fine to coarse, mainly limestone grains*	Channel					
		20	21.1D 21.2D 21.3D	20.00	20.2	-38.6			Channel					
	22-TW		22.1D	20.70					BB und					
			22.2D 22.3D 22.4U	20.90-21.15				*Loose, greyish brown, very gravelly, calcareous, fine to coarse SAND. Gravel is fine to medium, subrounded*						
		21	23.1U	21.50-21.85										
	23-TW				22.0	-40.4		*Stiff, greyish brown, sandy, gravelly, calcareous CLAY. Gravel is subrounded to subangular, fine to coarse, mainly limestone grains*	BB und					
		22			22.7	-41.1								
	24-LB		24.1D	22.80				*Loose, greyish brown, calcareous, fine to coarse GRAVEL* 22.50 - 22.55 fine greyish brown sand layer	SB					
		23	24.2D 24.3D 24.4D					*Hard, grey, sl. sandy, gravelly, very calcareous, CLAY. Gravel is fine to coarse, subrounded, mainly limestone grains*		63				
Geobor-S	25-C		25.1U	23.80-24.05										
		24	25.2D 25.3D 25.4D	24.20						54				
	26-C	25	26.1U	25.25-25.50						100				
		26												
	27-C									100				
		27	27.1D 27.2D 27.3D 27.4D	27.00										
	28-C		28.1U	27.80-28.05						80				
		28	28.2U	28.05-28.30										
	29-C		29.1D 29.2D 29.3D	28.50										
		29	29.4U	29.05-29.30										
	30-C		30.1U	29.80-31.30										

Undrained shear strength
— N_k=12 } Est. from CPT
— N_k=18 }
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Undrained shear strength		$CaCO_3$	w_P	w	w_L	PCPT Tip Resistance (MPa)	Point Load Strength $I_{s\,50}$	D_r (Baldi et al.)
1.26	0.51					158		
						148		
2.13	1.80					86		
2.17	1.80							
2.09	1.68							
2.08	1.69							
2.08	1.73							
2.07	1.77							
2.27	1.92							
2.24	1.86							
2.30	1.94							
2.27	1.92							
2.29	1.91							

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:48

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Borehole Log: ST13467-BH06	Drilled:	KEJ/KHH	Date: 2013-07-08	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared:	LTR/STK	Date: 2013-07-08	Encl No.: 1.1D.ST13467-BH06	
Remarks:	Checked:	ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved:	CLB	Date: 2014-01-28	Page: 1 / 2	

BH Log: ST13467-BH06

Coordinates (m): E: 388,191.4 N: 5,904,885 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -18.4

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Geobor-S (continued)	31-C	31						*Hard, grey, sl. sandy, gravelly, very calcareous, CLAY. Gravel is fine to coarse, subrounded, mainly limestone grains (continued)*	SB	100				
		32						31.35 50 mm white limestone layer		100				
	32-C	33	31.1D 31.2D 31.3D 31.4D 32.1U 32.2U 32.3U	32.70 33.00-33.25 33.25-33.50 33.85-34.10				31.90 - 32.10 w. dark grey clay, sl. gravelly		97			2.21 2.35	1.88 2.02
	33-C	34	33.1U	34.30-35.80						100				
	34-C	36	34.1D 34.2D 34.3D 34.4D	36.40						77			2.19	1.88
	35-C	38	35.1U 35.2U 35.3U	37.80-38.05 38.05-38.30 38.35-38.60				37.30 w. 50 x 70 mm limestone cobble		97			2.42	2.02
	36-C	39	36.1D 36.2D 36.3D 36.4D 36.5D	39.00 39.30-40.30						100			2.28	1.98
	37-C	41	37.5U 37.1D 37.2D 37.3D 37.4D	40.60-40.85 41.00				40.60 - 41.30 very gravelly. Gravel is medium to coarse, subrounded		93			2.19	1.78
	38-C	42	38.1U	41.80-43.20						93			2.23	1.86
	39-C	44	39.5U 39.6U	43.40-43.65 43.70-44.40						100				
	40-C	45	39.1D 39.2D 39.3D 39.4D	44.50						77			2.28	1.87
	41-C	47	41.1D 41.2D 41.3D 41.4D	46.65				46.40 30 x 30 mm char coal gravel		100			2.27	1.90
	42-C	48								100				
	43-C	50	43.1D 43.2D 43.3D 43.4D 43.5U	49.90 50.10-50.35	50.5	-68.9				96			2.27	1.92

Borehole Log: ST13467-BH06	Drilled: KEJ/KHH	Date: 2013-07-08	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: LTR/STK	Date: 2013-07-08	Encl No.: 1.1D.ST13467-BH06		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 2 / 2		

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:48

BH Log: ST13467-BH07

Coordinates (m): E: 390,504.7 N: 5,903,013 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.1

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Bailer	1-LB	0	1.1D	0.00	0.3	-20.4		*Very loose, greyish brown, very gravelly, sl. silty, sl. organic, sl. calcareous fine to coarse SAND. Gravel is fine and subangular to rounded, w. many shell fragments*	Seabed					
			1.2D	0.30					BB up					
			1.3D											
			1.4D											
	2-TW	1	2.1U	1.00-1.90				*Firm to very stiff, greyish brown, sandy, sl. gravelly, sl. calcareous CLAY. Gravel is fine and subangular to subrounded*						
	3-TW	2	3.1U	2.00-2.75				0.45 - 0.50 very gravelly						
					2.9	-23.0								
	4-TW	3	4.1D	3.20				*Firm to stiff, greyish brown, sandy, gravelly, calcareous CLAY. Gravel is fine and subangular to subrounded*	BB up					
			4.2D											
			4.3D											
			4.4D											
	5-TW	4	5.1D	4.20										
			5.2D											
			5.3D	4.50-4.70									2.17	1.96
			5.4U	4.70-4.90										
	6-TW	5	5.5U	5.00-5.90										
			6.1U											
	7-TW	6	7.1U	6.00-6.90										
					7.0	-27.1								
	8-TW	7	8.1D	7.10	7.5	-27.6		*Soft to firm, brownish grey, laminated, very sandy, sl. gravelly, calcareous CLAY. Gravel is fine and subrounded to subangular, w. 5-20 mm sand streaks*	BB mi					
			8.2D						BB lo					
			8.3D	7.50									2.16	1.89
			8.4D	7.60-7.80										
			8.5D	7.85										
	9-TW	8	8.6U	8.10				*Soft to firm, brownish grey, sandy, gravelly, calcareous CLAY. Gravel is fine, subangular to subrounded*					2.16	1.95
			8.7D	8.30-8.50										
			8.8D	8.50-8.70										
			9.1D											
			9.2D											
	10-TW	9	9.3D	9.00-9.90										
			9.4U											
			9.5U											
			10.1U											
	11-TW	10	11.1U	10.00-10.90				10.00 - 10.90 sandy, gravelly						
					11.0	-31.1								
Geobor-S	12-TW	11	12.1U	11.20-11.40	11.5	-31.6		*Firm to stiff, greyish brown, sandy, gravelly, calcareous CLAY. Gravel is fine to coarse, subangular to subrounded, mainly limestone grains*	BB lo	100	0	0	2.20	1.90
	13-C		12.2D	11.40				11.45 becoming grey and very calcareous	Chalk					
			12.3D	11.70										
			12.4D											
		12	13.1D											
			13.2D											
			13.3D		12.5	-32.6		*Very weak, low density, white CHALK. Matrix composed of sl. muddy uncompacted chalk. Clasts are very weak, low density, white chalk (CIRIA Dm, low density)*	Chalk	50	0	0		
	14-C	13						*Weak to moderately weak, low to medium density CHALK. Extremely closely to very closely spaced, closed or clean fractures (CIRIA A4/A5, low to medium density)*						
	15-C	14	15.1D	14.30						53	0	0		
					14.6	-34.7								
	16-C	15	16.1U	14.75-15.80				12.50 - 13.25 w. several 30-50 mm dark grey flint nodules	Chalk	84	0	0		
					15.5	-35.6		12.65 - 12.90 w. CIRIA Dm parts						
								14.00 - 14.40 w. few 1-2 mm marl flasers	Chalk					
					15.9	-36.0								
	17-C	16						*Very weak, low density, white CHALK. Matrix composed of sl. muddy uncompact chalk. Clasts are very weak, low density, white chalk (CIRIA Dm, low density)*	Chalk	67	0	0		
	C	17						*Very weak to weak, low density, white CHALK. Extremely closely to very closely spaced, close or clean fractures (CIRIA A, low density)*		0	0	0		
					18.0	-38.1								
	18-C	18						*Very weak, low density, white CHALK. Matrix are composed of sl. muddy uncompacted chalk. Clasts are very weak, low density, white chalk (CIRIA Dm, low density)*	Chalk	67	0	0		
	19-C	19	19.1U	19.45-19.65				16.00 - 16.10 w. low density CIRIA A parts		100	0	0		
								16.10 - 16.25 w. dark grey flint nodule						
	20-C	20						16.40 - 16.50 w. low density CIRIA A parts		100	0	0		
			20.1D	20.40				*Weak to moderately weak, low density, white CHALK. Extremely closely to closely spaced, closed or clean fractures (CIRIA A5-A3, low density)*						
			20.2D											
			20.3D											
	21-C	21	20.4D							72	28	11		
								18.25 - 18.45 dark grey flint nodules						
								18.25 - 18.50 low to medium density						
	22-C	22	22.1D	22.25				19.25 50 mm dark grey flint nodule		71	0	0		
								19.80 100 mm dark grey flint layer						
					23.0	-43.1		19.95 - 21.00 w. several 5-50 mm dark grey flint nodules						
	23-C	23	23.1U	23.10-24.10				21.00 - 21.65 w. several 1-2 mm marl seams and flasers	Chalk	91	55	27		
								Very weak to weak, low density, white CHALK. Extremely closely to medium spaced, closed or clean fractures (CIRIA A5-A2, low density)						
	24-C	24								75	25	17		
			24.1D	24.55										
			24.2D											
	25-C	25	25.1U	25.00-25.20				23.10 - 24.10 w. few 1-2 mm marl flasers and seams		90	60	40		
								23.40 - 23.90 w. low density CIRIA Dm parts						
								24.20 - 24.65 w. several bluish grey specks						
	26-C	26						24.40 100 mm dark grey flint layer		100	55	20		
								24.80 - 25.70 w. 1-5 mm grey marl flasers and seams						
	27-C	27	27.1U	27.25-27.50				25.45 - 25.65 w. diagonal fracture		100	50	45		
								25.80 - 26.80 w. few moderately weak parts						
								25.85 50 mm dark grey flint layer						
	28-C	28						26.55 50 mm dark grey flint layer		90	30	17		
								26.80 50 x 90 mm dark grey flint nodule						
		29												
	29-C									100	62	35		

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
◎ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

w_P w w_L
10 20 30 40 %

PCPT Tip Resistance (MPa)
2 4 6 8
20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH07	Drilled: KEJ/KHH	Date: 2013-07-09	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: LTR/STK	Date: 2013-07-09	Encl No.: 1.1D.ST13467-BH07		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 1 / 2		

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 10:02

BH Log: ST13467-BH07

Coordinates (m): E: 390,504.7 N: 5,903,013 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.1

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Geobor-S *(continued)*	30-C	30	29.1D 29.2D 29.3D 29.4D 29.5U	29.90 30.30-30.50				*Very weak to weak, low density, white CHALK. Extremely closely to medium spaced, closed or clean fractures (CIRIA A5-A2, low density) (continued)* 30.00 70 mm dark grey flint layer 30.60 w. many dark grey flint fragtments	Chalk	100	0	0		
	31-C	31								100	0	0		
	32-C	32	32.1U	33.35-33.60				33.20 - 33.30 w. dark grey flint layer 33.20 - 34.70 w. burrows		100	60	47		
	33-C	33	33.2U	34.70-36.15				34.20 50 mm dark grey flint nodule 34.70 - 36.15 widely spaced (CIRIA A1, low density)		97	93	93		
	34-C	34	33.1U	35.90-36.15				35.40 20 mm grey marl seam 36.30 100 mm dark grey flint layer		93	27	13		
	35-C	35						36.80 - 37.10 w. diagonal fracture		97	13	10		
	36-C	36	35.1D 35.2D	38.60				39.20 - 40.70 widely spaced (CIRIA A1, low density)		100	73	67		
	37-C	37	36.1U	39.55-39.80				40.20 50 mm dark grey flint layer		100	60	57		
	38-C	38	37.2U 37.1U	40.70-41.20 41.20-41.45				41.60 100 mm dark grey flint layer		47	0	0		
	39-C	39	37.3D 37.4D 37.5D 37.6D	41.90						100	50	0		
	40-C	40	39.1D 39.2D	43.80						80	67	50		
	41-C	41	40.1U	45.90-46.10				45.65 - 45.80 100 mm dark grey flint layer and 5-15 mm thinly laminated marl layer 45.90 - 46.10 10-30 mm light grey highly silicified nodules		81	35	35		
	42-C	42	41.1D 41.2D	47.60						100	97	67		
	43-C	43	42.1U	48.90-49.50	49.5	-69.6		48.90 40 x 60 mm grey to dark grey flint nodule						
		44						*Very weak to weak, low density, white CHALK. Widely spaced, closed or clean fractures (CIRIA A1, low density)*	Chalk	93	93	93		
		45												
		46												
		47												
		48												
		49												
		50	43.1U	50.80-50.80	50.9	-71.0								

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 10:02

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Borehole Log: ST13467-BH07	Drilled:	KEJ/KHH	Date: 2013-07-09	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared:	LTR/STK	Date: 2013-07-09	Encl No.: 1.1D.ST13467-BH07	
Remarks:	Checked:	ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved:	CLB	Date: 2014-01-28	Page: 2 / 2	

BH Log: ST13467-BH08

Coordinates (m): E: 394,435.1 N: 5,900,944.7 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.1

Drill tool: Dry rotary drilling

CPT stroke / Sample no. and type: 1-LB, 2-LB, 3-TW, 4-TW, 5-TW

Depth (m): 0, 1, 2, 3, 4, 5

Lab specimen

No. and type	Depth
1.1D	0.20
1.2D	
1.3D	
2.1D	1.10
2.2D	
2.3D	1.50
2.4D	1.80
2.5D	
2.6D	2.10
3.1D	2.30-2.50
3.2U	
4.1U	3.00-3.85
5.1U	4.00-4.85

Boundary (m): Depth / Elevation

Graphic Log

Geology

Description of *layers* and details

Formation

Core Runs and Core Quality: TCR (%), SCR (%), RQD (%)

Density (Mg/m³): Bulk, Dry

Bulk	Dry
2.07	1.76

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

PCPT Tip Resistance (MPa): 2 4 6 8 / 20 40 60 80

Point Load Strength $I_{s\,50}$: 0.1 0.2 0.3 0.4 MPa

D_r (Baldi et al.): 30 60 90 120 %

Other Tests: Grain size distribution, Gas test, Triax CID, Triax CAU, Permeability, Oedometer

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:52

W W W . G E O . D K

Borehole Log: ST13467-BH08	Drilled: ELF/BSM	Date: 2013-06-22	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared: LFJ/LTR	Date: 2013-08-20	Encl No.: 1.1D.ST13467-BH08	
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1	

BH Log: ST13467-BH08A

Coordinates (m): E: 394,431.9 N: 5,900,941.3 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Seabed Level (m): -20.7

Notes:

Drill tool: Dry rotary drilling

CPT stroke / Sample no. and type: 1-LB, 2-LB, 3-LB

Depth (m)

Lab specimen — No. and type / Depth:
- 1.1D 0.50
- 1.2D
- 1.3D
- 1.4D
- 1.5D 1.30
- 2.4D
- 2.5D
- 2.1D 1.80
- 2.2D
- 2.3D

Boundary (m) — Depth / Elevation

Graphic Log

Geology — Description of *layers* and details

Formation

Core Runs and Core Quality — TCR (%) / SCR (%) / RQD (%)

Density (Mg/m³) — Bulk / Dry

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L 10 20 30 40 %

PCPT Tip Resistance (MPa) 2 4 6 8 / 20 40 60 80

Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution / Gas test / Triax CID / Triax CAU / Permeability / Oedometer

Borehole Log: ST13467-BH08A	Drilled: JFP/BSM	Date: 2013-06-25	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared: LFJ/LTR	Date: 2013-08-20	Encl No.: 1.1D.ST13467-BH08A	
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1	

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:54

BH Log: ST13467-BH08B

Coordinates (m): E: 394,438.6 N: 5,900,941.7 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.9

Drill tool: Dry rotary drilling

CPT stroke / Sample no. and type

Depth (m)

Lab specimen: No. and type / Depth

No. and type	Depth
3.1U	1.10-1.70
4.1U	2.00-2.65
5.1D	3.20
5.2D	3.50
5.3D	
5.4D	3.75-3.95
5.6D	
5.5U	4.10
6.1D	4.25-4.45
6.2D	
6.3D	
6.4U	

Boundary (m): Depth / Elevation

Graphic Log

Geology: Description of *layers* and details

Formation

Core Runs and Core Quality: TCR (%) / SCR (%) / RQD (%)

Density (Mg/m³): Bulk / Dry

Depth	Bulk	Dry
3	2.14	1.83
4	2.32	2.00

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

PCPT Tip Resistance (MPa): 2 4 6 8 / 20 40 60 80

Point Load Strength $I_{s\,50}$: 0.1 0.2 0.3 0.4 MPa

D_r (Baldi et al.): 30 60 90 120 %

Other Tests: Grain size distribution / Gas test / Triax CID / Triax CAU / Permeability / Oedometer

*The majority of fractures is considered to have been induced by the drilling process

Borehole Log: ST13467-BH08B	Drilled: JFP/BSM	Date: 2013-06-25	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared: LFJ/LTR	Date: 2013-08-20	Encl No.: 1.1D.ST13467-BH08B	
	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1	

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:56

BH Log: ST13467-BH08C

Coordinates (m): E: 394,438.6 N: 5,900,941.7 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.9

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L
10 20 30 40 %

PCPT Tip Resistance (MPa)
2 4 6 8
20 40 60 80

Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Dry rotary drilling	1-LB	0	1.1D 1.2D 1.3D	0.50				*Medium dense, light dark brown, sl. gravelly, medium - coarse SAND. Gravel is fine and subrounded, w. few shell fragments*	Seabed					
	3-TW	1	1.4D 1.5D 3.1U	1.10-1.70	1.1	-23.0		*Soft to firm, brown, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subrounded to subangular, w. lime grains*	BB und					
	4-TW	2	4.1U	2.00-2.65										
	5-TW	3	5.1D 5.2D 5.3D	3.20 3.50	3.4 3.6	-25.3 -25.5		3.00 becoming firm and greyish brown						
	6-TW	4	5.4D 5.5U 5.6D 6.1D 6.2D 6.3D	3.75-3.95 4.10 4.25-4.45				*Medium dense, light olive brown, sl. clayey, gravelly, calcareous, fine to medium SAND. Gravel is fine to medium and subrounded to subangular*	BB und BB und				2.14 2.32	1.83 2.00
	7-TW	5	6.4U 7.1U	5.00-5.60				*Soft to firm, brown, sl. sandy, sl. gravelly, calcareous CLAY. Gravel is fine to medium and subrounded to subangular, w. lime grains*						
	8-TW	6	8.1U	6.00-6.70				6.00 becoming firm						
		7			7.0	-28.9		*Very loose to loose, greyish brown, sl. gravelly, calcareous, fine to medium SAND. Gravel is fine to medium and subrounded to subangular, w. few clayey parts, w. lime grains, w. few char coal pieces* 7.50 - 7.60 very gravelly 8.80 - 8.90 very gravelly	EG					
	9-B 10-LB	8	10.1D 10.2D 10.3D 10.4D 11.1D	7.90 8.60	9.5	-31.4		9.40 - 9.55 w. medium to coarse sand, w. shells and shell fragments	EG					
	11-LB	9	11.2D 11.3D	9.10										
	12-LB	10	11.4D 12.1D 12.2D 12.3D 12.4D	9.70 10.20	10.1 10.3	-31.9 -32.2		*Very dense, greyish brown, gravelly, calcareous, fine to medium SAND. Gravel is fine to medium and subrounded to subangular, w. few shell fragments*	EG EG					
	13-TW		12.5D 13.1D 13.2D	10.40 10.70	11.0	-32.8			EG					
Geobor-S	14-TW	11	13.3D 13.4D 14.2D	11.15 11.35-11.50	11.6	-33.4		*Very dense, grey, sl. clayey, gravelly, calcareous, medium SAND. Gravel is fine to coase and subrounded to subangular and consist of flint and granite, w. several shells and shell fragments*	EG				2.24	1.92
		12	14.3D 14.1U 14.4D 14.5D	11.65	12.5	-34.4								
	15-C	13	15.2D 15.3D 15.4D 15.1U	13.20 13.40-13.65				*Very dense, grey, sl. calcareous, medium SAND, w. few gravels* 10.50 - 10.95 w. few shell fragments	SB	97			2.36	2.10
	16-C	14	16.1D 16.2D 16.3D 16.4D	14.10-14.10 14.10	14.6	-36.4		*Stiff to very stiff, very dark grey, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subrounded to subangular, w. shell fragments*		57	0	0		
		15						*Very dense, very dark grey, clayey, sl. gravelly, calcareous SAND. Gravel is fine and subrounded, w. shell fragments*	Chalk					
	17-C	16	17.1D 17.2D	16.20	15.8 16.5	-37.6 -38.4		*Firm, grey, sandy, gravelly, calcareous CLAY. Gravel is fine to coarse, subrounded to subangular, w. lime grains* 12.80 w. 55x60 mm gravel 14.40 w. 60x90 mm dark grey flint	Chalk	90	20	0		
	18-C	17	18.1D 18.2D	17.20				*Very weak, low density, white CHALK. Matrix composed of uncompact muddy chalk. Clasts are very weak, low density and white (CIRIA Dm, low density)*	Chalk	93	57	30		
	19-C	18	19.3D 19.4D 19.5D 19.6D	18.10				*Very weak, low density, white CHALK, extremely closely spaced, closed or clean fractures (CIRIA A5, low density)*		100	33	10		
		19	19.1D 19.2D	19.20										
	20-C	20						*Very weak to weak, low density, white CHALK, closely spaced, closed or clean fractures (CIRIA A3, low density)* 16.60 w. few 50x50 mm black flint nodules 16.60 - 16.70 w. structureless chalk (CIRIA Dm) 17.20 w. fossile 17.60 w. 40x90 mm black fractured flint 18.70 w. several 1-3 mm marl flasers 18.80 - 18.85 w. several dark grey flint nodules 20.70 w. fossils 21.50 w. 50 mm grey marl layers 22.30 w. several 2-10 mm grey marl seams		90	7	0		
	21-C	21	21.1D 21.2D	21.40						107	40	17		
		22			22.5	-44.4			Chalk	100	20	0		
	22-C	23	22.1D 22.2D	23.00	24.0	-45.9		*Weak, low density, white CHALK, very closely spaced, closed or clean fractures (CIRIA A4, low density)* 22.50 - 22.80 w. parts of strong chalk 22.90 - 23.05 w. diagonal marl filled fractures 23.10 - 23.20 w. several 1 mm greenish grey marl flasers 23.60 w. 5 mm greenish grey marl seam 23.75 w. 10mm greenish grey marl seam	Chalk	100	57	33		
	23-C	24							Chalk					
		25	23.3D 23.4D	25.00	25.2 25.5	-47.1 -47.4			Chalk					
	24-C	26	23.1D 23.2D 24.1D 24.2D	25.50 26.20	27.0	-48.9		*Moderately strong, high density, light grey CHALK, closely spaced, closed or clean fractures (CIRIA A3, high density)* 24.40 - 24.90 rich in grey marly flasers 24.90 - 25.20 greenish grey marl layer		100	3	0		
	25-C	27						*Very weak to weak, low density, white CHALK, very closely spaced, closed or clean fractures (CIRIA A4, low density)*	Chalk	100	30	7		
		28	25.1D 25.2D	28.10	28.5	-50.4		*Very weak to weak, low density, white CHALK, extremely to very closely spaced, open or infilled fractures (CIRIA B4/B5, low density)* 25.70 - 25.90 w. diagonal marl filled fracture 26.40 w. glauconite	Chalk	100	20	12		
	26-C	29												
	27-C		26.1D 26.2D	29.60	29.8	-51.6		*Weak, low density, white CHALK, closely*		93	17	7		

Borehole Log: ST13467-BH08C	Drilled: JFP/BSM	Date: 2013-06-26	Report No.: 1.1
Project: 36685 Dudgeon	Prepared: LFJ/LTR	Date: 2013-06-28	Encl No.: 1.1D.ST13467-BH08C
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1
	Approved: CLB	Date: 2014-01-28	Page: 1 / 2

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:59

BH Log: ST13467-BH08C

Coordinates (m): E: 394,438.6 N: 5,900,941.7 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.9

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Geobor-S (continued)	28-C	30	28.1D 28.2D	31.60	31.2	-53.1		*spaced, open or infilled fractures (CIRIA B3, low density)* 27.25 - 27.30 w. marl filled diagonal fracture 27.45 w. several 1 mm marl flasers	Chalk					
		31						*Weak to moderately weak, low to high density, white CHALK, closely spaced, closed or clean fractures (CIRIA A3, low to high density)* 28.85 w. several 1 mm marl flasers	Chalk	100	23	0		
	29-C	32	29.1U	32.85-33.05				*Weak to moderately weak, medium to high density, white CHALK, very closely spaced, closed or clean fractures (CIRIA A3, medium to high density) (continued)*		100	90	90		
	30-C	33	30.2D 30.3D 30.4D 30.5D	34.30	34.2	-56.1		*Weak, low density, white CHALK, closely spaced, closed or clean fractures (CIRIA A3, low density)* 31.40 w. vertical fracture 31.60 w. vertical fracture 31.70 w. 200 mm moderately strong chalk	Chalk	100	37	100		
		34	30.1U	35.00-35.20				31.90 - 32.05 rich in grey marl flasers 32.00 - 32.10 w. diagonal fracture 32.30 - 32.35 rich in burrows 32.30 - 32.40 rich in grey marl flasers 33.60 - 34.10 rich in grey marl flasers						
	31-C	35			35.7	-57.6		*Weak to moderately strong, high to very high density, white to light grey CHALK, very closely spaced, closed or clean fractures (CIRIA A4, high to very high density)* 34.85 - 34.90 w. several grey marl flasers 35.20 - 35.60 rich in burrows	Chalk	103	47	20		
	32-C	36	31.1D 31.2D	37.00	37.3	-59.1		*Moderately weak, high density, light grey CHALK, very closely spaced, closed or clean fractures (CIRIA A4, high density)* 36.10 - 36.25 marly	Chalk	97	24	7		
		37						*Weak, low density, white CHALK, closely spaced, closed or clean fractures (CIRIA A3, low density)*		100	57	13		
	33-C	38	33.1U	39.60-39.80	38.7	-60.6		*Weak to moderately weak, medium to high density, white CHALK, closely spaced, closed or clean fractures (CIRIA A3, medium to high density)* 38.80 - 39.40 w. diagonal fracture 39.70 - 40.10 grey 40.50 - 40.60 w. diagonal fractures 40.55 - 40.60 w. burrows	Chalk	100	53	33		
		39						*Moderately weak to moderately strong, high density, light grey CHALK, closely spaced, closed or clean fractures (CIRIA A3, high to very high density)* 41.70 - 42.60 w. several burrows	Chalk	107	77	43		
	34-C	40	34.1U	41.30-41.50	41.7	-63.6		*Moderately weak to moderately strong, high to very high density, light grey CHALK, very closely to medium spaced, closed or clean fractures (CIRIA A3/A4, high to very high density)* 44.05 - 45.00 w. several burrows	Chalk	100	50	40		
		41								93	73	43		
	35-C	42	35.1U	42.70-42.90	43.2	-65.1		*Weak, low to medium density, light grey CHALK, closely spaced, open or infilled fractures (CIRIA B3, low to medium density)* 46.00 - 46.70 w. several burrows 46.50 - 46.70 w. infilled diagonal fractures	Chalk	100	80	67		
	36-C	43								100	3	0		
	37-C	44	37.2D 37.3D 37.4D 37.5D 37.1U	43.90 44.10-44.30	45.2	-67.1		*Weak, low to medium density, light grey CHALK, very closely spaced, closed or clean fractures (CIRIA A4, low to medium density)* 47.30 - 47.60 w. several burrows 48.80 - 49.10 w. several 1 mm marl flasers	Chalk	93	30	17		
	38-C	45	38.1U	45.85-46.00	46.7	-68.6				100	80	67		
		46												
	39-C	47	39.1D 39.2D	47.70	49.7	-71.6				93	30	17		
	40-C	48												
		49												
	41-C	50	40.1D 40.2D	49.45	50.1	-72.0		*Moderately weak to moderately strong, high to very high density, light grey CHALK, very closely spaced, open or infilled fractures (CIRIA B4, high to very high density)* 49.70 w. infilled fracture 50.00 w. several greenish grey marl flasers	Chalk	113	25	0		

Borehole Log: ST13467-BH08C	Drilled: JFP/BSM	Date: 2013-06-26	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared: LFJ/LTR	Date: 2013-06-28	Encl No.: 1.1D.ST13467-BH08C	
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved: CLB	Date: 2014-01-28	Page: 2 / 2	

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 15:59

BH Log: ST13467-BH09

Coordinates (m): E: 388,344.4 N: 5,907,010.4 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.5

Undrained shear strength
— N_k=12 } Est. from CPT
— N_k=18 }
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Geology: Formation	Core Runs and Core Quality: TCR (%)	Core Runs and Core Quality: SCR (%)	Core Runs and Core Quality: RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
	1-TW	0	1.1D	0.30									2.17	1.71
			1.2D	0.45-0.65										
			1.3D											
			1.4U											
	2-TW	1	2.1U	1.00-1.60										
	3-TW	2	2.1U	2.00-2.95										
	4-TW	3												
			4.1D	3.30										
			4.2D	3.55-3.75									2.08	1.78
			4.3D											
			4.4D											
	5-TW	4	4.5U											
			5.1D	4.30										
			5.2D	4.45-4.65									2.23	1.92
			5.3D											
			5.4U											
	6-TW	5	6.1U	5.00-5.95										

UU

UU

Borehole Log: ST13467-BH09	Drilled: JFP/BSM	Date: 2013-06-27	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: MBM	Date: 2013-08-20	Encl No.: 1.1D.ST13467-BH09		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1		

GEO
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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 16:01

BH Log: ST13467-BH09A

Coordinates (m): E: 388,339.7 N: 5,907,009.5 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.3

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Bailer	1-LB	0	1.5D	0.05	0.1	-21.4		*Very loose, greyish brown, sl. clayey, very gravelly, calcareous, fine to coarse SAND. Gravel is subrounded to subangular, w. shell fragments, w. organic specks*	Seabed / BB und				2.41	2.05
			1.2D	0.25										
			1.3D	0.40-0.60										
			1.4D											
		1	1.1U											
	2-TW		2.1U	1.30-1.90				*Firm to stiff, greyish brown, sandy, gravelly, calcareous, CLAY. Gravel is fine to medium, subrounded to subangular*						
	3-TW	2	3.1U	2.30-3.20										
		3												
	4-TW		4.1D	3.55									2.20	1.90
			4.2D	3.90										
		4	4.3D											
			4.4D											
	5-TW		5.1U	4.75-4.95										
		5	5.2U	4.95-5.15	5.4	-26.6							2.18	1.91
			5.3D	5.35				*Stiff, laminated, greyish brown, silty, calcareous CLAY, w. many silt and fine sand laminae*	BB und					
			5.4D	5.45										
			5.5D		6.0	-27.3		5.45 3 mm fine sand laminae	BB und					
	6-TW	6	5.6D	6.00-6.80				*Stiff, greyish brown, sandy, gravelly, calcareous CLAY. Gravel is fine to medium, subrounded to subangular and mainly limestone grains*						
			6.1U											
		7												
	7-TW		7.1U	7.40-8.10										
		8												
	8-TW		8.1U	8.60-8.80									2.17	1.91
			8.2D	8.95										
		9	8.3D		9.3	-30.6								
	9-LB		8.4D					*Very dense, olive brown, calcareous, fine to medium SAND, w. shell fragments*	EG					
			9.1D	9.50				9.85 - 9.90 rich in shell fragments						
			9.2D	10.00				10.10 - 10.30 w. several dark brown organic specks						
		10	9.3D					10.70 - 10.90 w. char coal pieces						
	10-LB		9.4D											
			10.1D	10.60				11.30 becoming dark greyish brown, w. few char coal pieces						
		11	10.2D	11.00										
			10.3D											
	11-LB		10.4D	11.40										
			11.1D											
			11.2D											
		12	11.3D											
	12-LB		12.1D	12.40										
			12.2D											
			12.3D											
		13			13.3	-34.6								
	13-TW		13.1U	13.30-13.70				*Stiff to very stiff, grey, sandy, sl. gravelly, calcareous CLAY. Gravel is fine and subrounded, w. many chalk fragments, w. few dark grey specks*	SB					
	14-TW		14.1U	13.80-14.25										
		14			14.3	-35.6		13.80 becoming hard	SB					
	15-TW		15.1U	14.30-14.60										
Geobor-S	16-C		16.1D	14.90				*Hard, grey, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subrounded, w. many chalk fragments*		100			2.21	1.84
		15	16.2D	15.20-15.45				14.30 - 14.60 very gravelly						
			16.3D											
			16.4D											
			16.5U	15.70-15.95										
		16	16.6U	15.95-16.20										
	17-C									100			2.23	1.81
			17.1U	16.90-17.15				16.65 100 mm dark grey, sl. clayey, sandy, silt layer						
		17	17.2U	17.15-17.40				16.90 50 mm dark grey, sl. clayey, sandy, silt layer						
	18-C									100	23	17		
		18												
					19.0	-40.2		18.70 - 18.95 w. many chalk lumps and pebbles	Chalk					
			18.1D	19.00				*Very weak to weak, low density, white CHALK, extremely closely to closely spaced, closed or clean fractures, w. many light grey to grey marl seams and flasers, w. few dark grey specks and <10 mm lumps (CIRIA A3-A5, low density)*		97	90	73		
	19-C		18.2D											
		19	18.3D											
										100	100	73		
		20						20.15 - 20.45 w. 45 degrees fractures, w. clay smeares (<< 1 mm)						
	20-C		20.1D	20.80										
		21	20.2U	21.05-21.25										
	21-C									100	100	77		
		22						23.00 5 mm platey fossil fragment						
								23.25 w. glaucunite						
	22-C		22.1D	24.00						100	80	27		
		23												
		24			25.3	-46.6		25.05 - 25.25 highly silicified, w. glauconite parts, w. many 1-2 mm glauconite crystals	Chalk	97	53	30		
	23-C							*Very weak to weak, low density, white CHALK, extremely closely to closely spaced, closed or clean fractures, w. dark grey flint layers and nodules, w. few marl flasers and seams (CIRIA A5-A3, low density)*						
		25						26.40 - 26.75 w. many marl filled, brownish grey burrows						
								27.40 120 mm dark grey flint layer						
	24-C		23.1D	26.70				27.70 - 27.90 w. sub-vertical clean fracture		90	77	0		
		26												
					28.3	-49.6			Chalk	97	87	0		
	25-C													
		27												
		28												
		29	25.1D	29.10										
	26-C													

Undrained shear strength
— N_k=12 } Est. from CPT
— N_k=18 }
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 16:03

GEO W W W . G E O . D K

Borehole Log: ST13467-BH09A	Drilled: KEJ/KHH	Date: 2013-07-04	Report No.: 1.1
Project: 36685 Dudgeon	Prepared: LTR/STK	Date: 2013-07-05	Encl No.: 1.1D.ST13467-BH09A
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1
	Approved: CLB	Date: 2014-01-28	Page: 1 / 2

BH Log: ST13467-BH09A

Coordinates (m): E: 388,339.7 N: 5,907,009.5 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.3

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Geobor-S (continued)		30						*Very weak to moderately weak, low to medium density, white CHALK, extremely closely to closely spaced, clean or closed fractures, w. few dark grey flint layers and nodules, w. few light grey to grey marl seams and layers, w. very few glauconite crystals (CIRIA A5-A3, low to medium density) (continued)*	Chalk	80	73	10		
		31												
	27-C		27.1D	31.30						93	70	0		
		32												
	28-C		28.1D	33.00				30.05 80 mm dark grey flint layer 30.45 60 mm dark grey flint layer 30.85 50 mm dark grey flint layer 32.10 80 mm dark grey flint layer 32.20 - 32.50 w. sub-vertical clean fracture 32.80 100 mm dark grey flint layer		90	90	0		
		33	28.2D 28.3D	33.40										
			28.4D 28.5D	33.60										
		34						34.00 100 mm marly to clayey layer						
	29-C									80	57	23		
		35	29.1D	35.20										
	30-C	36								87	27	0		
		37						37.00 80x80 mm dark grey flint nodule						
	31-C		31.1D	37.65						83	57	0		
		38												
	32-C	39								87	73	20		
			32.1D	39.60				39.70 - 39.80 w. light bluish grey flint layer and <10 mm flint nodules						
		40												
	33-C									80	0	0		
		41												
	34-C	42	34.1U	42.15-42.35						97	80	20		
		43												
	35-C		35.1D	43.50				43.45 50 mm dark grey flint nodule		77	13	7		
		44	35.2D 35.3D 35.4D	43.70				44.00 50 mm flint layer 44.35 - 44.45 w. grey flint layer						
	36-C	45						44.95 50 mm dark grey flint nodules		83	3	0		
			36.1D 36.2D	45.45										
		46						45.90 100 mm dark grey flint layer						
	37-C									80	10	0		
		47						46.90 50 mm dark grey flint nodule						
	38-C	48	38.1D 38.2D	48.05				48.15 90 mm grey flint layer		27	13	7		
		49												
	39-C		39.1U	49.50-49.70						93	47	33		
		50	39.2D 39.3D 39.4D 39.5D	49.90	50.0	-71.3		49.70 several 1 mm dark grey marl flasers 49.90 50x90 mm dark grey flint nodule						

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 16:03

GEO
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Borehole Log: ST13467-BH09A	Drilled: KEJ/KHH	Date: 2013-07-04	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: LTR/STK	Date: 2013-07-05	Encl No.: 1.1D.ST13467-BH09A		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 2 / 2		

BH Log: ST13467-BH10

Coordinates (m): E: 390,073 N: 5,905,609 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.9

Drill tool: Bailer; Geobor-S

CPT stroke / Sample no. and type

Depth (m)

Lab specimen: No. and type / Depth

Boundary (m): Depth / Elevation

Graphic Log

Geology

Description of *layers* and details

Formation

Core Runs and Core Quality: TCR (%) / SCR (%) / RQD (%)

Density (Mg/m³): Bulk / Dry

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)

— 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution / Gas test / Triax CID / Triax CAU / Permeability / Oedometer

Depth	Elevation	Description of *layers* and details	Formation	TCR (%)	SCR (%)	RQD (%)	Bulk	Dry
0.3	-21.2	*Loose, brown, gravelly, calcareous, medium to coarse SAND. Gravel is fine to medium and subangular to subrounded, w. several shell fragments, w. plant remains*	Seabed / BB up				2.29	1.96
		Firm, brown, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded						
		8.30 - 9.70 becoming firm to very stiff		46 / 70 / 70 / 80			2.33	1.95
9.3	-30.2	*Firm, brown, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded*	BB mi	27				
10.8	-31.7							
11.0	-31.9	*Loose, grey, gravelly, clayey, calcareous SAND. Gravel is fine to medium and subrounded*	BB mi / BB mi	73				
11.6	-32.5							
11.7	-32.6	*Firm to stiff, brown, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subrounded*	BB mi / BB mi	47				
12.3	-33.2							
12.4	-33.3	*Loose, grey, very gravelly, clayey, calcareous SAND. Gravel is fine to medium and subrounded*	BB mi / BB lo	64 / 69				
		Firm to stiff, brown, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded		93				
		Loose, greyish brown, very gravelly, very clayey, calcareous SAND. Gravel is fine to medium and subrounded		88			2.24	1.92
15.3	-36.2	*Firm to stiff, brown, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded*	SB	100				
		Very stiff to hard, light grey, sandy, gravelly, very calcareous CLAY. Gravel is fine to coarse and subangular to subrounded		63			2.37	2.10
19.5	-40.4			85	0	0		
		Very weak, low density, white CHALK. Matrix composed of uncompacted muddy chalk, clasts are very weak, low density, white chalk (CIRIA Dm, low density) 19.60 60x75 mm black flint nodule	Chalk	60	0	0		
24.6	-45.5	*Weak, low density, white CHALK, extremely closely to medium spaced, closed or clean, w. several 1-3 mm thick grey marl seams (CIRIA A5/A3, low density)*	Chalk	0 / 100 / 85	0 / 75 / 85	0 / 30 / 0		
		27.50 150 mm black flint layer		100 / 100	0 / 100	0 / 93		
		29.50 100 mm black flint layer		100	60	47		

Lab specimen:

No. and type	Depth
1.1D	0.10
1.2D	
1.3D	0.40
1.4U	0.50-0.70
2.1U	1.00-1.50
3.1U	2.00-2.70
4.1D	3.00-4.00
4.2D	
4.3D	
4.4D	
5.1D	4.20
5.2D	4.35-4.55
5.3D	
5.4U	
7.1U	6.45-6.85
8.4U	7.40-7.60
8.1D	7.80
8.2D	
8.3D	
9.1U	8.30-8.95
11.1D	10.90
13.1U	12.45-12.70
14.1D	13.45
14.2D	
14.3D	13.90-14.15
15.1U	14.15-14.40
15.2U	
16.1U	14.50-15.60
17.1U	15.85-16.10
17.2U	16.10-17.20
17.3D	17.20
17.4D	17.30-17.95
17.5D	
18.1U	
18.2U	17.95-18.20
19.1D	19.00
19.2D	
19.3D	
23.1D	25.90
23.2D	26.10
24.1D	26.70
24.2D	27.20
26.1D	28.00
26.2D	
26.3D	
26.4D	
26.5U	28.75-29.00

CPT stroke / Sample no.: 1-LB, 2-TW, 3-TW, 4-B, 5-TW, 6-C, 7-C, 8-C, 9-C, 10-C, 11-C, 12-C, 13-C, 14-C, 15-C, 16-C, 17-C, 18-C, 19-C, 20-C, C, 21-C, 22-C, C, 23-C, 24-C, 25-C, 26-C, 27-C

Depth (m): 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29

GEO W W W . G E O . D K

Borehole Log: ST13467-BH10	Drilled:	KEJ/KHH	Date: 2013-07-16	Report No.: 1.1
Project: 36685 Dudgeon	Prepared:	KRA/ULG/STK	Date: 2013-07-16	Encl No.: 1.1D.ST13467-BH10
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked:	ABP/NKA	Date: 2014-01-28	Rev : 1
	Approved:	CLB	Date: 2014-01-28	Page: 1 / 2

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 16:05

BH Log: ST13467-BH10

Coordinates (m): E: 390,073 N: 5,905,609 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.9

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Geobor-S *(continued)*	28-C	30	28.1D	30.90				*Weak, low density, white CHALK, extremely closely to medium spaced, closed or clean, w. several 1-3 mm thick grey marl seams (CIRIA A5/A3, low density) (continued)*	Chalk	67	47	40		
		31	28.2D	31.40										
								31.70 - 31.80 w. several 30 x 80 mm black flint nodules						
	29-C	32								95	85	75		
		33	29.1D	33.20										
	30-C		29.2D	33.40-33.60						100	100	37		
			30.1U											
			30.2D	33.80				33.70 - 33.80 w. several black flint nodules						
		34	30.3D											
			30.4D					34.20 - 34.30 w. several black flint nodules						
			30.5D											
	31-C	35								70	40	0		
	32-C		32.1U	35.90-36.10						100	100	100		
		36												
		37												
	33-C									80	80	80		
		38	33.1D	38.40										
			33.2D											
	34-C									87	50	50		
		39												
		40	34.1D	40.00	40.3	-61.2								
			34.2D											
	35-C							*Weak, low density, white CHALK, closely to medium spaced, closed or clean, w. a few marl seams (CIRIA A3, low density)*	Chalk	93	79	57		
			35.1U	40.70-41.00				41.10 50 mm black flint layer						
		41												
	36-C									100	67	60		
		42						42.60 100 mm black flint layer						
		43	36.1D	43.10										
	37-C		36.2D	43.20-43.50						100	77	77		
			37.1U											
		44												
	38-C									77	50	33		
		45						45.20 - 45.25 w. black flint nodules						
			38.1D	45.60										
			38.2D											
	39-C	46								100	64	21		
		47						46.90 50 mm grey marl layer						
			39.1D	47.20										
	40-C		39.2D	47.40-48.70						100	93	93		
		48	40.2U											
								48.50 60x30 mm black flint nodule						
			40.1U	48.70-48.90										
	41-C	49								100	100	62		
								49.40 100 mm grey marl layer						
		50	41.1D	50.00	50.2	-71.1								
			41.2D											
			41.3D											
			41.4D											

Borehole Log: ST13467-BH10	Drilled: KEJ/KHH	Date: 2013-07-16	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared: KRA/ULG/STK	Date: 2013-07-16	Encl No.: 1.1D.ST13467-BH10	
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved: CLB	Date: 2014-01-28	Page: 2 / 2	

GEO WWW.GEO.DK

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 16:05

BH Log: ST13467-BH11

Coordinates (m): E: 394,189 N: 5,897,798.9 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -22.4

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Bailer	1-TW	0	1.1D	0.20				*Very stiff, greyish brown, very sandy, sl. gravelly CLAY. Gravel is fine and subangular to subrounded*	BB und					
			1.2D	0.50-0.70										
			1.3D											
			1.4U											
	2-TW	1	2.1U	1.00-1.55									2.18	1.86
	3-TW	2	3.1U	2.00-2.70										
	4-TW	3	4.1D	3.05									2.16	1.88
			4.2U	3.20-3.40										
			4.3U	3.40-3.60										
			4.4D	3.65										
			4.5D											
	5-TW	4												
			5.1U	4.40-4.60									2.23	1.92
			5.2U	4.60-4.80										
			5.3D	4.85				4.70 becoming gravelly						
	6-TW	5	5.4D	5.00-5.80										
			6.1U											
	7-TW	6	7.1U	6.00-6.40										
					6.5	-28.8								
	8-TW		8.1D	6.50				*Hard, very pale brown, sandy, very gravelly, very calcareous CLAY. Gravel is fine, subangular to subrounded and mostly limestone*	BB und					
	9-TW	7	9.1D	7.05				7.00 - 7.20 w. sand streaks						
	TW 10-B													
Geobor-S	11-TW	8	11.1D	8.10				8.00 becoming sl. gravelly, w. olive yellow, sand streaks and pockets		37	0	0		
			11.2D		8.4	-30.8			Chalk					
	12-C		11.3D					*Very weak to weak, low density, light grey CHALK. Matrix composed of sl. muddy uncompacted chalk, clasts are very weak, low density, white chalk*						
		9						*(CIRIA Dm, low density)*						
	13-C		13.1U	9.40-11.00				8.40 w. 150 mm dark grey flint layer		100	0	0		
		10						8.40 - 8.85 w. marl and clay streaks						
								9.40 - 11.00 w. several grey patches						
					11.0	-33.4								
	14-C	11						*Very weak to weak, low density, white CHALK, extremely closely spaced, closed og clean fractures, w. a few 1-2 mm marl flasers and seams*	Chalk	67	0	0		
		12						*(CIRIA A5, low density)*						
	15-C							11.85 w. 50 mm dark grey flint nodule		93	0	0		
		13	15.1D	13.00										
			15.2D											
			15.3D											
			15.4D											
	C	14								0	0	0		
		15												
	16-C							15.50 - 15.80 w. several 20 x 40 mm dark grey flint nodules		50	0	0		
	17-C	16								100	0	0		
	18-C		18.1U	16.35-17.30				16.45 - 17.20 w. parts of low density, sl. muddy, uncompacted white chalk w. clasts of very weak low density white chalk		100	0	0		
		17						(CIRIA Dm)						
	19-TW 20-C		19.1U	17.40-17.60				17.30 - 17.40 w. many flint fragments		100	25	21		
		18												
					18.7	-41.1								
	21-C	19						*Weak, low density, white CHALK, extremely to very closely spaced, closed or clean fractures*	Chalk	95	0	0		
			22.1U	19.20-20.70				*(CIRIA A4/A5, low density)*						
	22-C	20						18.90 w. 100 x 150 mm dark grey flint nodule		100	60	60		
								19.65 - 20.50 w. parts of low density, sl. muddy, uncompacted white chalk w. clasts of very weak low density white chalk						
	23-C		23.1D	20.80				(CIRIA Dm)		87	10	7		
		21	23.2D	21.25				21.30 - 21.50 w. grey specks						
					21.9	-44.2								
	24-C	22	24.1U	22.50-22.70				*Very weak to weak, low density, white CHALK, closely spaced, closed or clean*	Chalk	100	90	70		
								(CIRIA A3, low density)						
	25-C	23						22.90 w. 50 mm dark grey flint nodule		87	33	27		
								23.20 - 24.25 w. a few 1-2 mm flasers and seams						
								23.50 w. 50 mm dark grey flint layer						
		24	25.1D	24.25										
			25.2D											
	26-C		26.1D	24.85				24.60 - 24.80 w. grey patches		100	20	10		
		25	26.2D											
			26.3D											
			26.4D											
					25.7	-48.1								
	27-C	26	27.1U	25.85-26.10				*Weak to moderately weak, low to medium density, white CHALK, closely spaced, closed or clean fractures*	Chalk	67	33	27		
								25.70 - 28.15 w. several 1-2 mm grey marl seams and flasers						
		27			27.2	-49.6		26.10 - 26.40 w. diagonal fracture						
	28-C		28.1U	27.20-27.45				*Very weak to weak, low density, white CHALK, closely spaced, closed or clean fractures*	Chalk	95	45	40		
		28						28.20 - 29.70 w. a few burrows		100	40	13		
	29-C													
		29												
			29.1D	29.50										
	30-C		29.2D					29.70 - 30.80 w. burrows		73	40	20		

Borehole Log: ST13467-BH11	Drilled: KEJ/KHH	Date: 2013-07-10	Report No.: 1.1
Project: 36685 Dudgeon	Prepared: LTR/STK	Date: 2013-07-10	Encl No.: 1.1D.ST13467-BH11
Remarks: HCL testing not performed offshore	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1
	Approved: CLB	Date: 2014-01-28	Page: 1 / 2

W W W . G E O . D K

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 10:04

BH Log: ST13467-BH11

Coordinates (m): E: 394,189 N: 5,897,798.9 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -22.4

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Geobor-S *(continued)*	31-C	31	31.1U	31.25-31.45				*Very weak to weak, low density, white CHALK, closely spaced, closed or clean fractures (continued)* 30.55 - 30.65 w. grey patches	Chalk	100	43	27		
		32			32.7	-55.1								
	32-C	33	32.1D 32.2D	32.90				*Very weak to weak, low density, white CHALK, very closely spaced, closed or clean fractures (CIRIA A4, low density)*	Chalk	53	23	13		
	C	34								0	0	0		
	C	35								0	0	0		
	33-C	36	33.1D 33.2D	36.60				36.45 becoming extremely to very closely spaced (CIRIA A4/A5, low density)		100	9	0		
	34-C	37	34.1D 34.2D 34.3D 34.4D	37.40				36.45 - 36.50 w. several dark grey flint nodules 37.00 - 38.25 w. several 1-2 mm marl seams and flasers		83	10	7		
	35-C	39	35.1U	38.60-38.80				38.50 - 38.65 w. a diagonal fracture 38.50 - 39.00 medium spaced (CIRIA A2, low density)		80	37	30		
	36-C	40	36.1D 36.2D	40.25						100	67	20		
	37-C	41								53	0	0		
					41.7	-64.1								
	38-C	42	38.1D 38.2D	42.10				*Very weak to weak, low density, white CHALK, medium spaced, closed or clean fractures (CIRIA A2/A3, low density)* 41.70 w. several dark grey flint nodules 42.05 w. several dark grey flint nodules	Chalk	80	73	40		
	39-C	43	39.1U	42.45-43.40						100	74	68		
	40-C	44						43.40 - 44.60 very closely to closely spaced (CIRIA A3/A4, low density)		80	20	10		
			40.1D 40.2D	44.50										
	41-C	45						45.05 - 45.30 w. grey specks 45.40 w. 20 x 100 mm dark grey flint nodule		90	63	63		
		46	41.1U	45.75-46.00										
	42-C	47	42.1U	46.40-47.70				46.70 - 47.80 w. 100 mm flint nodule 47.00 - 47.80 w. few marl flasers		87	80	40		
					47.9	-70.3								
	43-C	48	43.1D	48.10				*Very weak to weak, low density, white CHALK, extremely closely to very closely spaced, closed og clean fractures (CIRIA A5/A4, low density)* 47.90 - 50.40 w. marl flasers and seams and few burrows 48.55 - 49.10 vertical fractures 49.50 - 49.60 w. two dark grey flint nodules	Chalk	87	63	0		
		49	43.2D 43.3D 43.4D 43.5D	48.60										
	44-C	50	43.6D 44.1U	49.40-50.40						91	82	55		
					50.5	-72.9								

GEO WWW.GEO.DK	Borehole Log: ST13467-BH11	Drilled: KEJ/KHH	Date: 2013-07-10	Report No.: 1.1
	Project: 36685 Dudgeon	Prepared: LTR/STK	Date: 2013-07-10	Encl No.: 1.1D.ST13467-BH11
	Remarks: HCL testing not performed offshore	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1
		Approved: CLB	Date: 2014-01-28	Page: 2 / 2

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 10:04

BH Log: ST13467-BH11A

Coordinates (m): E: 394,193.9 N: 5,897,798.8 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -22.1

Drill tool: Geobor-S

CPT stroke / Sample no. and type: 1-C, 2-C, 3-C, 4-C

Depth (m): 0, 1, 2, 3, 4, 5, 6

Lab specimen — No. and type / Depth:

No. and type	Depth
1.1U	0.00-1.05
2.1U	1.50-2.60
3.1U	3.00-3.65
4.1U	4.50-4.90

Geology — Boundary (m) Depth / Elevation; Graphic Log; Description of *layers* and details; Formation

Depth	Elevation	Description of *layers* and details	Formation
0.0	-22.1	*Stiff to very stiff, greyish brown, very sandy, sl. gravelly CLAY. Gravel is fine and subangular to subrounded*	
6.0	-28.1	4.50 becoming very stiff to hard, gravelly	

Core Runs and Core Quality: TCR (%), SCR (%), RQD (%)

TCR (%)	SCR (%)	RQD (%)
70		
73		
43		
27		

Density (Mg/m³): Bulk, Dry

Undrained shear strength
— N_k=12 } Est. from CPT
— N_k=18 }
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH11A	Drilled:	KEJ/KHH	Date:	2013-07-10	Report No.: 1.1
Project: 36685 Dudgeon	Prepared:	LTR/STK	Date:	2013-07-10	Encl No.: 1.1D.ST13467-BH11A
Remarks: No lab. testing performed offshore (all samples saved)	Checked:	ABP/NKA	Date:	2014-01-28	Rev : 1
	Approved:	CLB	Date:	2014-01-28	Page: 1 / 1

GEO WWW.GEO.DK

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 16:09

BH Log: ST13467-BH12

Coordinates (m): E: 392,201 N: 5,903,894 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.2

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Dry rotary drilling	1-TW	0	1.1U	0.00-0.60				*Very stiff, dark greyish brown, calcareous, sandy, gravelly CLAY. Gravel is rounded to subangular and fine to coarse, mainly limestone grains*	BB up					
	2-B							0.60 - 1.00 w. several layers of gravely fine to coarse sand, w. shell fragments						
	3-TW	1	3.1U	1.00-1.65				1.00 becoming stiff						
	4-LB	2						2.00 - 2.15 clayey fine sand layers						
			4.1D	2.50										
			4.2D											
			4.3D		3.0	-24.2								
	5-TW	3	4.4D					*Stiff, greyish brown, calcareous, sandy, gravelly CLAY. Gravel is rounded to subrounded and fine to coarse, mainly limestone grains*	BB up					
			5.1U	3.30-3.55										
			5.2U	3.60-3.85										
	6-TW	4	6.1U	4.00-4.85	4.0	-25.2		*Very loose, brown, calcareous, sl. gravelly, fine to medium SAND. Gravel is subangular to subrounded and fine to coarse, w. char coal pieces, w. a few clay lumps*	BB und				2.26	1.94
	7-TW	5	7.1U	5.00-5.90	5.0	-26.2		*Stiff, greyish brown, calcareous, sandy, gravelly CLAY. Gravel is subrounded to subangular and fine to coarse, mainly limestone grains*	BB und					
	8-TW	6	8.1U	6.10-6.30									2.16	1.83
			8.2U	6.30-6.55										
			8.3D	6.60										
			8.4D											
			8.5D											
	9-TW	7	9.1U	7.20-7.40									2.14	1.70
			9.2U	7.40-7.65										
			9.3D	7.70										
			9.4D											
	10-TW	8	9.5D	8.00-8.75										
			10.1U											
					9.0	-30.2								
	11-TW	9	11.1U	9.00-9.40				*Dense, greyish brown, calcareous, very silty, gravelly, fine SAND. Gravel is subrounded to subangular and fine to medium*	EG					
					10.0	-31.2								
	12-TW	10						*Very weak, low density, white CHALK. Matrix composed of muddy chalk. Clasts are very weak, low density, white chalk (CIRIA Dm, low density)*	Chalk	100	0	0		
Geobor-S	13-C		13.1D	10.20										
			13.2D											
			13.3D											
			13.4D		11.0	-32.2								
	14-C	11						10.00 - 10.05 dense, greyish brown, calcareous, medium to fine sand	Chalk	100	10	0		
			14.1D	11.80				10.05 - 10.10 w. 90x70 mm black flint nodule						
					12.0	-33.2								
	15-C	12	14.2D					*Weak, low density, white CHALK. Extremely closely to closely spaced, closed or clean fractures (CIRIA A3/A5, low density)*	Chalk	100	0	0		
			14.3D											
			14.4D											
			15.1U	12.70-13.40										
		13												
	16-C		16.1D	13.70				*Very weak, low density, white CHALK. Matrix composed of muddy chalk. Clasts are very weak, low density, white chalk (CIRIA Dm, low density)*		93	3	0		
			16.2D											
		14	16.3D											
			16.4D		14.5	-35.7		12.60 w. 50x40 mm black flint nodule						
								12.70 w. some greyish burrows	Chalk					
								14.10 w. 20x30 mm black flint nodule						
	17-C	15						*Weak, low density, white CHALK. Extremely closely spaced, closed or clean fractures, w. marl flasers (CIRIA A5, low density)*		100	0	0		
			17.1U	15.70-16.50										
		16						15.00 - 15.05 w. 30x10 mm black flint nodule						
	18-C									27	0	0		
		17						16.80 w. 90x50 mm black flint nodule						
	19-C	18						18.00 - 18.10 w. 30x50 mm black flint nodules		100	80	53		
			19.1D	18.50										
			19.2D	18.75										
	20-C	19	19.3D							72	36	36		
			19.4D					19.25 w. 50x30 mm black flint nodule						
			19.5D											
		20								0	0	0		
					21.0	-42.2								
	21-C	21	21.1U	21.20-21.70				*Very weak, low density, white CHALK. Matrix composed of muddy chalk. Clasts are very weak, low density, white chalk (CIRIA Dm, low density)*	Chalk	100	0	0		
					21.8	-42.9			Chalk	100	40	30		
	22-C	22	22.1U	22.00-22.15				*Weak, low density, white CHALK. Extremely closely to closely spaced, closed or clean fractures, w. greyish marl burrows and seams (CIRIA A3/A5, low density)*						
			22.2D	22.20										
			22.3D	22.30										
			22.4D											
	23-C	23	22.5D					22.75 - 22.85 w. 90x70 mm black flint nodule		90	73	27		
			22.6D											
		24								0	0	0		
	24-C	25								100	70	50		
			24.1D	25.60										
			24.3D	25.70-25.90										
	25-C	26	24.4D							80	70	35		
			24.2D											
			24.5U											
	26-C	27								100	87	17		
								27.40 w. 20x30 mm black flint nodule						
		28	26.1D	28.20				28.10 w. 50x40 mm black flint nodule						
	27-C		26.2D											
			26.3D											
			26.4D											
		29			29.0	-50.2				60	0	0		
CPT-A														

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

2 4 6 8 PCPT Tip Resistance (MPa)

20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH12	Drilled:	LNP/TA	Date:	2013-08-02	Report No.: 1.1
Project: 36685 Dudgeon	Prepared:	LTR/ULG	Date:	2013-08-02	Encl No.: 1.1D.ST13467-BH12
Remarks:	Checked:	ABP/NKA	Date:	2014-01-28	Rev : 1
	Approved:	CLB	Date:	2014-01-28	Page: 1 / 1

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 10:07

BH Log: ST13467-BH13

Coordinates (m): E: 389,750 N: 5,908,261.1 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.2

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Bailer	1-TW	0	1.1D	0.30	0.2	-21.4		*Very loose, dark grey, sl. organic, sl. gravelly, calcareous SAND. Gravel is fine to medium and subrounded, w. shell fragments*	Seabed					
			1.2D	0.40-0.60					BB up				2.14	1.87
			1.3D											
	2-TW	1	1.4U					*Stiff to very stiff, dark greyish brown, sandy, sl. gravelly, calcareous CLAY. Gravel are fine and subrounded, basicaly limestone*					2.15	1.87
	3-TW	2	2.1U	1.35-1.55										
	4-TW	3	3.1U	2.00-2.75										
	5-TW	4	4.1U	3.00-3.90										
			5.1D	4.20										
			5.2D	4.40-4.60									2.22	2.03
			5.3D	4.60-4.80										
			5.4U		5.0	-26.2								
	6-TW	5	5.5U					*Stiff to very stiff, dark greyish brown, sandy, sl. gravelly, calcareous CLAY. Gravel are fine and subrounded, basicaly limestone*	BB mi					
			6.1D	5.20				5.00 - 5.15 loose, dark grey, calcareous sand						
			6.2D	5.35				5.30 - 5.40 loose, dark grey, calcareous sand						
			6.3D											
	7-TW	6	7.1U	6.00-6.80										
	8-TW	7	8.1U	7.00-7.40										
					8.0	-29.2								
	9-TW	8	9.1U	8.25-8.45				*Stiff to very stiff, dark greyish brown, sandy, sl. gravelly, calcareous CLAY. Gravel are fine and subrounded, basicaly limestone*	BB lo				2.23	2.13
			9.2D	8.50				9.00 - 9.05 loose to medium dense, dark grey, calcareous sand						
			9.3D	8.70-8.90				9.25 - 9.35 loose to medium dense, dark grey, calcareous sand					2.16	1.87
			9.4D											
	10-TW	9	9.5D											
			10.1D	9.30										
			10.2U	9.40-9.60										
			10.3D	9.65										
	11-TW	10			10.5	-31.7								
	12-LB		12.1D	10.60				*Medium dense to dense, dark grey, calcareous, fine to medium SAND, w. shell fragments*	EG					
			12.2D					10.80 - 11.10 w. silt lumps, w. charcoal pieces						
		11	12.3D	11.00										
			12.4D											
	13-B		12.5D											
			12.6D											
		12	12.7D											
		13			13.5	-34.7								
	14-TW		14.1U	13.50-13.90				*Hard, grey, sandy, gravelly, very calcareous CLAY. Gravel is fine to medium and subangular to subrounded, mostly limestone*	SB					
Geobor-S	15-TW	14	15.1U	14.00-14.60						100				
	16-C		16.4U	14.70-14.95										
		15	16.1D	15.00										
			16.2D											
			16.3D											
	17-C		17.1U	15.75-16.00						100			2.30	1.99
		16	17.2U	16.00-16.25										
			17.3U	16.25-16.50										
			17.4U	16.50-16.75										
	18-C	17	18.1U	17.10-17.35						100				
		18												
	19-C		19.1U	18.50-19.10						97			2.31	1.99
		19			19.1	-40.3								
								Very weak, low density, white, CHALK. Matrix composed of uncompacted muddy chalk. Clasts are very weak, low density, white chalk	Chalk					
					20.0	-41.2		19.10 - 19.60 w. several 1-2 cm light grey clay layers (transition zone)	Chalk	100	100	73		
	20-C	20	20.1D	20.10				19.15 50x60 mm black flint nodule						
			20.2D					*Weak, low density, white CHALK, extremely closely spaced to very closely spaced, closed or clean, w. few marl seams*						
								20.25 - 20.30 w. grey marl seams						
		21						21.90 - 22.60 weak, low density, white, chalk, w. glauconite and mineralization (infilled fracture)						
	21-C									100	53	13		
		22												
	22-C	23	22.1D	23.10						87	73	20		
			22.2D					23.70 - 23.80 w. light grey chalk						
		24												
	23-C		23.1D	24.60						100	100	27		
		25	23.2D					25.50 - 26.00 w. several black flint nodules						
	24-C	26						26.10 100 mm black flint nodule		87	87	0		
			24.1D	27.00										
		27	24.2D											
			24.3D		27.5	-48.7								
			24.4D											
			24.5D											
			24.6D											

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
◎ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH13	Drilled:	KEJ/KHH	Date:	2013-07-16	Report No.: 1.1
Project: 36685 Dudgeon	Prepared:	KRA/ULG/STK	Date:	2013-07-16	Encl No.: 1.1D.ST13467-BH13
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked:	ABP/NKA	Date:	2014-01-28	Rev : 1
	Approved:	CLB	Date:	2014-01-28	Page: 1 / 1

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-01-31 16:13

BH Log: ST13467-BH14

Coordinates (m): E: 395,918 N: 5,903,272 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -25.5

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Bailer	1-TW	0	1.1D	0.10	0.5	-26.0		*Loose, brown, gravelly, calacareous, medium to coarse SAND. Gravel is fine to medium and subangular to subrounded*	Seabed					
			1.2D	0.60					BB und					
	2-TW	1	2.1U	1.30-1.90				*Firm to stiff, brown, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded*						
	3-TW	2	3.1U	2.30-3.15										
	4-TW	3	4.1D	3.40	3.6	-29.1		3.30 - 3.55 loose, brown, calcareous, sl. silty, fine sand	BB und				2.10	1.67
			4.2U	3.65-3.85										
			4.3D	4.00				*Firm to stiff, brown, thinly to thickly laminated, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, w. fine to medium sand laminae*						
		4	4.4D											
	5-TW		4.5D	4.50										
			5.2D										1.94	1.56
			5.3D	4.70-4.90										
		5	5.4D											
			5.1U											
	6-TW		6.1U	5.30-6.05										
		6												
	7-TW		7.1U	6.30-6.90										
		7												
	8-TW		8.1U	7.40-7.60									1.95	1.52
			8.2D	7.70										
			8.3D											
		8	8.4D											
	9-TW		9.1D	8.50										
			9.2D	8.70-8.90									1.99	1.63
			9.3D											
		9	9.4U											
	10-TW		10.1U	9.30-10.15										
		10												
	11-TW		11.1U	10.30-11.15										
		11												
	12-TW		12.1U	11.60-11.80									2.08	1.64
			12.2D	11.90										
		12	12.3D											
			12.4D											
	13-TW		13.1U	12.45-12.65									1.91	1.44
			13.2D	12.70										
		13	13.3D											
			13.4D											
	14-TW		14.1U	13.30-13.80										
		14			14.3	-39.8								
	15-TW		15.1U	14.30-15.20				*Compacted, dark greyish brown, sl. clayey, very fine sandy SILT* 14.30 - 14.70 might be disturbed	Silt					
		15												
	16-TW		16.1D	15.40										
			16.2D											
			16.3D											
		16			16.8	-42.3								
	TW													
	17-LB		17.1D	16.90				*Medium dense, grey, very gravelly, calcareous, medium to coarse SAND. Gravel is fine to medium and subangular to subrounded*	Lag					
		17												
	18-LB		18.1D	17.90										
	19-B	18												
	20-B				19.0	-44.5								
	21-B	19						*Very weak, low density, white CHALK. Matrix composed of uncompacted muddy chalk, clasts are very weak, low density, white, chalk. (CIRIA Dm, low density)*	Chalk					
	22-TW													
	23-B				20.0	-45.5								
	24-C	20							Chalk	87	87	25		
Geobor-S			24.1D	20.50				*Very weak, low density, white CHALK, extremely closely to closely spaced, closed or clean, w. few marl seams (CIRIA A3/A5, low density)*						
	25-C		24.2D							62	62	31		
			24.3D											
		21	24.4D											
			25.1D	21.50										
			25.2D											
	26-C	22	26.1U	22.40-22.70						100	100	75		
		23						23.00 - 23.05 w. black flint nodule						
	27-C									100	100	80		
		24												
	28-C		27.1D	24.70				24.65 - 24.75 w. black flint layers 24.80 - 26.30 w. converging fractures		100	80	0		
		25	27.2D											
			28.1D	25.70										
			28.2D											
		26												
	29-C							26.35 - 26.50 w. black flint layer		100	100	20		
			29.1D	26.70										
			29.2D											
		27	29.3D											
			29.4D											
			29.5D											
			29.6D											
	30-C									100	100	13		
		28	30.1D	28.10										
			30.2D											
		29												
	31-C		31.1D	29.40				29.45 - 29.55 w. black flint layer		90	53	0		
			31.2D											

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

PCPT Tip Resistance (MPa) 2 4 6 8 — 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH14	Drilled:	KEJ/KHH	Date: 2013-07-17	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared:	KRA/ULG/STK	Date: 2013-07-17	Encl No.: 1.1D.ST13467-BH14	
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked:	ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved:	CLB	Date: 2014-01-28	Page: 1 / 2	

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 10:09

BH Log: ST13467-BH14

Coordinates (m): E: 395,918 N: 5,903,272 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -25.5

Drill tool | CPT stroke | Sample no. and type | Depth (m) | Lab specimen: No. and type, Depth | Boundary (m): Depth, Elevation | Graphic Log | Geology: Description of *layers* and details | Formation | Core Runs and Core Quality: TCR (%), SCR (%), RQD (%) | Density (Mg/m³): Bulk, Dry | Undrained shear strength | $CaCO_3$ | PCPT Tip Resistance (MPa) | Point Load Strength $I_{s\,50}$ | D_r (Baldi et al.) | Other Tests: Grain size distribution, Gas test, Triax CID, Triax CAU, Permeability, Oedometer

Undrained shear strength: N_k=12, N_k=18 } Est. from CPT; △ Pocket Pen ▲ Tor Vane; ⊙ Lab Vane ◇ Fall Cone; ● Intact UU ■ UCS; ⊗ Rem. Lab vane/Fall cone; 200 400 600 800 kPa

$CaCO_3$: 4 8 12 16 %

w_P w w_L; 10 20 30 40 %

PCPT Tip Resistance (MPa): 2 4 6 8; 20 40 60 80

Point Load Strength $I_{s\,50}$: 0.1 0.2 0.3 0.4 MPa

D_r (Baldi et al.): 30 60 90 120 %

Other Tests: Grain size distribution, Gas test, Triax CID, Triax CAU, Permeability, Oedometer

Depth	Elevation	Description of *layers* and details	Formation
30.8	-56.3	30.45 30 mm grey marl seam	Chalk

Borehole Log: ST13467-BH14	Drilled:	KEJ/KHH	Date:	2013-07-17	Report No.:	1.1
Project: 36685 Dudgeon	Prepared:	KRA/ULG/STK	Date:	2013-07-17	Encl No.:	1.1D.ST13467-BH14
Remarks: *The majority of fractures is considered to have been induced by the drilling process	Checked:	ABP/NKA	Date:	2014-01-28	Rev :	1
	Approved:	CLB	Date:	2014-01-28	Page:	2 / 2

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 10:09

BH Log: ST13467-BH15

Coordinates (m): E: N: Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m):

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
	1-TW	0						*Firm to stiff dark greyish brown, calc., sandy, gravelly CLAY. Gravel is fine to coarse and subrounded to subangular), w. char coal pieces.* 0.00 - 0.90 w. sand lumps 1.00 - 1.35 w. char coal pieces						
	2-TW	1	2.1U	1.00-1.35										
	3-TW	2	3.1D	2.00				2.00 - 2.20 turning greyish brown						
	4-B													
	5-TW	3	5.1D	3.40									2.19	1.88
			5.2D	3.60-3.80										
			5.3D											
	6-TW	4	5.4U	4.00										
			6.1D											
	7-B		6.2D		4.5			4.30 - 4.50 w. sand streaks and shell fragments						
	8-TW		6.3D	4.60										
			8.1D											
	9-LB	5	8.2D	5.00				*Very dense olive brown, calc., sl. gravelly fine SAND. Gravel is fine to medium, rounded to subrounded, w. a few shell fragments.* 5.00 - 6.25 w. a. few clay lumps						
			9.1D											
			9.2D											
	10-LB	6	10.1D	6.10	6.3			*Very dense brownish grey, sl. calc, fine SAND, w. a few shell fragments.*						
			10.2D	6.25										
			10.3D											
	11-B		11.1D											
	12-LB	7	12.1D	7.20				7.00 - 8.00 w. a few gravels						
			12.2D											
			12.3D											
	13-LB	8	13.1D	8.20				7.80 - 7.90 rich in dark grey clay laminae, w. many char coal pieces						
			13.2D	8.40				8.00 - 8.50 w. many char coal pieces, w. a few plant remains						
	14-B		13.3D											
			13.4D		9.0			8.50 - 9.00 v. gravelly, w. many shells and shell fragments						
		9												

Undrained shear strength
N_k=12, N_k=18 } Est. from CPT
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L
10 20 30 40 %

PCPT Tip Resistance (MPa)
2 4 6 8
20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH15	Drilled:	Date: 2013-07-30	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared: LTR/ULG	Date:	Encl No.: 1.1D.ST13467-BH15	
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1	

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-01 21:04

BH Log: ST13467-BH15+BH15A

Coordinates (m): E: 395,829 N: 5,902,216.1 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -23.6

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Dry rotary drilling	1-TW	0						*Firm to stiff, dark greyish brown, calcareous, sandy, gravelly CLAY. Gravel is fine to coarse and subrounded to subangular, w. char coal pieces.*	BB up					
	2-TW	1	2.1U	1.00-1.35				0.00 - 0.90 w. sand lumps						
	1A-TW		1A.1U	1.20-1.95				1.00 - 1.35 w. char coal pieces						
	3-TW	2	3.1D	2.00				2.00 turning greyish brown						
	2B-TW		2A.1D	2.30										
	4-B		2A.2D										2.20	1.97
			2A.3D	2.60-2.80										
	5-TW	3	2A.4U										2.19	1.88
			5.1D	3.40										
			5.2D	3.60-3.80										
	6-TW	4	5.3D											
			5.4U	4.00										
	7-B		6.1D											
			6.2D		4.5	-28.1		4.30 - 4.50 w. sand streaks and shell fragments						
	8-TW		6.3D	4.60					EG					
			8.1D					*Very dense, olive brown, calcareous, sl. gravelly fine SAND. Gravel is fine to medium, rounded to subrounded, w. a few shell fragments.*						
	9-LB	5	8.2D	5.00										
			9.1D											
			9.2D											
	10-LB	6	10.1D	6.10	6.3	-29.9		5.00 - 6.25 w. a. few clay lumps						
			10.2D	6.25					EG					
			10.3D					*Very dense, brownish grey, sl. calcareous, fine SAND, w. a few shell fragments.*						
	11-B		11.1D											
	12-LB	7	12.1D	7.20				7.00 - 8.00 w. a few gravels						
			12.2D											
			12.3D											
	13-LB	8	13.1D	8.20				7.80 - 7.90 rich in dark grey clay laminae, w. many char coal pieces						
			13.2D	8.40				8.00 - 8.50 w. many char coal pieces, w. a few plant remains						
	14-B		13.3D											
			13.4D		9.0	-32.6		8.50 - 9.00 v. gravelly, w. many shells and shell fragments						
	15-TW	9	15.1U	9.00-9.60					SB					
					10.0	-33.6		*Stiff, grey, calcareous, sandy, gravelly CLAY. Gravel is subrounded to subangular and fine to medium, mainly limestone grains.*	SB					
	16-TW	10	16.1U	10.00-10.80				*Very stiff, dark grey, calcareous, v. sandy, gravelly CLAY. Gravel is subrounded to subangular and fine to coarse, mainly limestone grains.*						
	17-TW	11	17.1D	11.10									2.31	2.06
			17.2D											
	18-TW		17.3D	11.50-11.70										
			18.1U											
Geobor-S	19-C	12						12.00 - 12.80 sandy		100				
			19.1D	12.40										
			19.2D	12.55-12.80										
	20-C		19.3D							93			2.42	2.21
		13	19.4U											
										110				
	21-C	14	21.1U	14.20-14.45									2.49	2.25
			21.2D	14.60										
			21.3D											
		15	21.4D											
	22-C	16								90				
			22.1D	16.60				16.25 w. 100x80 mm limestone cobble						
			22.2D	16.80-17.05				16.75 w. 50x50 mm limestone gravel					2.54	2.33
		17	22.3D											
	23-C		22.4U							73	0	0		
		18			18.0	-41.6			Chalk					
			23.1D	18.20				*Very weak, low density, white, strutureless CHALK. Matrix composed of uncompact muddy chalk. Clasts are very weak, low density, white.*						
			23.2D		18.8	-42.4		*(CIRIA Dm, low density)*	Chalk	75	50	25		
			23.3D					18.25 w. a. few 2 mm grey marl laminae						
	24-C	19						*Very weak, low density, white CHALK. Extremely closely to closely spaced, closed or clean fractures.*		80	25	0		
			24.2D	19.30				*(CIRIA A3/A5, low density)*						
			24.1D	19.55				19.25 w. fossils						
	25-C	20								55	15	15		
			26.1D	21.05										
	26-C	21	26.2D											
	27-C	22						21.95 w. horisontal fracture		80	10	0		
	28-C		28.1D	22.50				22.35 - 22.40 w. several 1-2 mm grey marl laminae		65	20	15		
			28.2D											
			28.3D							62	13	0		
	29-C	23	28.4D											
			29.1D	23.50										
	30-C		29.2D							80	30	0		
		24												
					24.8	-48.4		24.55 - 24.60 grey marl layer						
CPT-A		25												
		26												

Undrained shear strength: N_k=12, N_k=18 } Est. from CPT; Pocket Pen, Tor Vane, Lab Vane, Fall Cone, Intact UU, UCS, Rem. Lab vane/Fall cone; 200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L 10 20 30 40 %

PCPT Tip Resistance (MPa) 2 4 6 8 — 20 40 60 80

Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH15+BH15A	Drilled:	LNP/TA	Date: 2013-08-01	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared:	LTR/ULG	Date: 2013-08-01	Encl No.: 1.1D.ST13467-BH15+BH15A	
Remarks:	Checked:	ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved:	CLB	Date: 2014-01-28	Page: 1 / 1	

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 10:11

BH Log: ST13467-BH15A

Coordinates (m): E: N: Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m):

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
	1A-TW	1	1A.1U	1.20-1.95										
	2B-TW	2	2A.1D 2A.2D 2A.3D 2A.4U	2.30 2.60-2.80									2.20	1.97
	15-TW	9	15.1U	9.00-9.60				*Stiff grey, clac., sandy, gravelly CLAY. Gravel is subrounded to subangular and fine to medium, mainly limestone grains.*						
	16-TW	10	16.1U	10.00-10.80	10.0			*Very stiff dark grey, calc., v. sandy, gravelly CLAY. Gravel is subrounded to subangular and fine to coarse, mainly limestone grains.*						
	17-TW	11	17.1D 17.2D	11.10									2.31	2.06
	18-TW		17.3D 18.1U	11.50-11.70										
	19-C	12	19.1D	12.40				12.00 - 12.80 sandy		100				
	20-C	13	19.2D 19.3D 19.4U	12.55-12.80						93			2.42	2.21
	21-C	14	21.1U	14.20-14.45									2.49	2.25
		15	21.2D 21.3D 21.4D	14.60						110				
	22-C	16						16.25 w. 100x80 mm limestone cobble 16.75 w. 50x50 mm limestone gravel		90			2.54	2.33
			22.1D	16.60										
		17	22.2D 22.3D 22.4U	16.80-17.05										
	23-C	18	23.1D 23.2D 23.3D	18.20	18.0			*Very weak, low density, white, strutureless CHALK. Matrix composed of uncompact muddy chalk. Clasts are very weak, low density, white.* *(CIRIA Dm, low density)*		73	0	0		
	24-C	19	24.2D 24.1D	19.30 19.55	18.8			18.25 w. a. few 2 mm grey marl laminae *Very weak, low density, white CHALK. Extremely closely to closely spaced, closed or clean fractures.* *(CIRIA A3/A5, low density)*		75	50	25		
	25-C	20								80	25	0		
	26-C	21	26.1D 26.2D	21.05				19.25 w. fossils		55	15	15		
	27-C	22						21.95 w. horisontal fracture		80	10	0		
	28-C		28.1D 28.2D 28.3D	22.50				22.35 - 22.40 w. several 1-2 mm grey marl laminae		65	20	15		
	29-C	23	28.4D							62	13	0		
			29.1D 29.2D	23.50										
	30-C	24			24.8			24.55 - 24.60 grey marl layer		80	30	0		

Undrained shear strength
— N_k=12 } Est. from CPT
— N_k=18 }
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH15A	Drilled:	Date: 2013-07-31	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared: LTR/ULG	Date:	Encl No.: 1.1D.ST13467-BH15A	
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1	

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-02 10:21

BH Log: ST13467-BH16

Coordinates (m): E: 395,280 N: 5,901,385 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -23.0

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Bailer	1-TW	0	1.1D	0.00	0.3	-23.3		*Very loose, light yellowish brown, sl. gravelly, fine to medium SAND. Gravel is fine to medium and subrounded to runded, w. shell fragments* 0.25 - 0.30 very gravelly	Seabed BB up					
			1.2D	0.30										
			1.3D											
			1.4D											
			1.5D		1.0	-24.0								
	2-TW	1	2.1U	1.00-1.70					BB up					
	3-TW	2	3.1U	2.00-2.90				*Very soft, greyish brown, very sandy, gravelly CLAY. Gravel is subangular to subrounded, w. many sand pockets and streaks*						
								Firm, greyish brown, very sandy, gravelly, calcareous CLAY. Gravel is subangular to subrounded 2.00 - 2.90 stiff to very stiff 2.90 - 4.00 firm to stiff					2.16	1.88
	4-TW	3	4.1D	3.10										
			4.2D											
			4.3D	3.40-3.60										
			4.4U	3.60-3.80	3.9	-26.9								
			4.5U											
	5-TW	4	5.1U	4.20-4.40				*Firm, greyish brown, very sandy, gravelly, calcareous CLAY. Gravel is subangular to subrounded* 4.00 - 4.80 soft to firm 4.75 - 4.90 stiff to very stiff, w. fine to medium sand laminae and streaks 4.90 - 6.90 stiff	BB und				2.13	1.85
			5.2D	4.60										
			5.3D	4.75										
	6-TW	5	5.4D	5.00-5.90										
			5.5D											
			6.1U											
	7-TW	6	7.1U	6.00-6.90										
	8-TW	7	8.1D	7.20				6.90 - 7.80 stiff to very stiff						
			8.2D											
			8.3D	7.50-7.70	7.8	-30.8							2.12	1.86
			8.4U											
	9-LB	8	9.1D	8.10				*Dense to very dense, brownish grey, fine to medium SAND, w. few fine gravels, w. few silty lumps*	EG					
			9.2D		8.5	-31.5								
			9.3D	8.45	8.8	-31.8			EG					
			9.4D	8.75				*Stiff to very stiff, greyish brown, very sandy, gravelly, calcareous CLAY. Gravel is subangular to subrounded*	EG					
			9.5D											
	10-LB	9	9.6D											
			9.7D	9.30										
			10.1D											
			10.2D	9.75										
			10.3D											
	11-LB	10	10.4D	10.10				*Dense to very dense, brownish grey to grey, fine to medium SAND* 9.00 - 9.80 w. few fine gravels, w. few silty lumps 9.65 - 10.45 w. shell fragments 10.00 - 10.45 sl. silty, w. few fine and angular gravels						
			10.5D	10.35	10.5	-33.5								
			11.1D											
			11.2D											
			11.3D											
		11												
		12												
		13												
		14												
		15												
		16												
		17												
		18												
		19												
		20												
		21												
		22												

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

2 4 6 8 PCPT Tip Resistance (MPa)

20 40 60 80

Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH16	Drilled: KEJ/KHH	Date: 2013-07-10	Report No.: 1.1
Project: 36685 Dudgeon	Prepared: LTR/STK	Date: 2013-07-10	Encl No.: 1.1D.ST13467-BH16
Remarks: HCL testing not performed offshore	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-02 11:33

BH Log: ST13467-BH17

Coordinates (m): E: 392,068.5 N: 5,906,378.5 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.9

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Dry rotary drilling	1-TW	0	1.1U	0.00-0.90				*Stiff, dark greyish brown, sandy, silty, gravelly, calcareous CLAY. Gravel is fine to medium and subrounded to subangular, mainly limestone*	BB up					
					1.0	-22.9		0.00 loose, pale brown, fine sand	BB mi					
	2-TW	1	2.1D	1.10				*Stiff, dark greyish brown, sandy, silty, gravelly, calcareous CLAY. Gravel is fine to medium and subrounded to subangular, mainly limestone*						
			2.2D	1.25				1.00 - 1.25 loose, dark grey, silty, clayey, gravelly, slightly calcareous, medium sand. Gravel is fine to medium and subrounded					2.18	1.88
			2.3D											
			2.4D											
	3-TW	2	2.5D	2.00										
			2.6D	2.20										
			3.1D	2.30-2.45										
			3.2D											
			3.3D											
	4-TW	3	3.4D	3.00-3.55										
			3.5D											
			3.6D											
			3.7U											
			4.1U					2.00 - 2.20 loose, gravelly silty, slightly calcareous, coarse sand, gravel is angular						
					4.0	-25.9								
	5-TW	4	5.1D	4.00				*Stiff, dark greyish brown, sandy, silty, gravelly, calcareous CLAY. Gravel is fine to medium and subrounded to subangular, mainly limestone*	BB lo					
			5.2D											
			5.3D	4.30-4.50									2.16	1.86
			5.4U					4.00 - 4.50 firm						
	6-TW	5	6.1D	5.00										
			6.2D	5.25-5.45										
			6.3D	5.50-5.65										
			6.4U										2.22	1.90
			6.5U											
	7-TW	6	7.1U	6.00-6.80				6.00 - 6.80 very stiff						
	8-TW	7	8.1U	7.00-7.55				7.00 - 7.55 very stiff						
	9-TW	8	9.1D	8.00				8.00 - 8.60 very stiff						
	10-TW		9.2D											
			9.3D	8.40-8.60										
			9.4U										2.15	1.85
		9	10.1D	9.00										
			10.2D		9.2	-31.1		9.00 - 9.30 very stiff	Chalk					
	11-D							*Very weak, low density white CHALK. Matrix composed of uncumpacted muddy chalk, clasts are very weak, low density, white chalk, pieces of flint, fine to coarse (CIRIA DM, low density)*						
	11A-LB													
	12-LB				10.1	-31.9		9.50 - 9.60 loose, crushed flint, fine to coarse						
		10												
		11												
		12												
		13												
		14												
		15												
		16												
		17												
		18												
		19												
		20												
		21												
		22												
		23												
		24												

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)

— 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH17	Drilled: LNP/TA	Date: 2013-08-07	Report No.: 1.1
Project: 36685 Dudgeon	Prepared: DO/ULG	Date: 2013-08-07	Encl No.: 1.1D.ST13467-BH17
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-02 13:50

BH Log: ST13467-BH18

Coordinates (m): E: 393,896.2 N: 5,904,894.4 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -23.6

Boundary Depth (m)	Boundary Elevation	Description of *layers* and details	Formation
0.5	-24.1	*Loose, greyish brown, gravelly, sl. silty, calcareous, fine to coarse SAND. Gravel is fine to coarse and subrounded to subangular, w. shell fragments.*	Seabed / BB up
		Firm to stiff, greyish brown, gravelly, sandy, calcareous CLAY. Gravel is fine to medium and subangular to subrounded. Gravel is basically limestones. 0.45 - 0.60 sl. gravelly, very sandy, very silty	
3.0	-26.6		
3.2	-26.8	*Loose greyish brown, sl. silty, sl. calcareous, fine to medium SAND.*	BB mi
3.3	-26.9		BB mi
3.5	-27.1		BB mi
4.0	-27.6	*Firm to stiff, greyish brown, gravelly, sandy, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, mainly limestone grains.*	BB mi / BB lo
		Loose greyish brown, sl. silty, sl. calcareous, fine to medium SAND.	
		Firm to stiff, greyish brown, gravelly, sandy, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, mainly limestone grains.	
6.5	-30.1	*Stiff, greyish brown, gravelly, sandy, calcareous CLAY. Gravel is fine to medium and subrounded to subangular, basically limestone, w. few fine to medium sand laminae.* 4.00 - 4.05 loose, greyish brown, very gravelly, calcareous, fine to medium SAND	BB lo
8.0	-31.6	*Very stiff, greyish brown, silty, sl. sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subrounded to subangular.* 7.25 - 7.50 very gravelly	EG
9.5	-33.1		Chalk
10.0	-33.6	*Dense, light olive brown, gravelly, calcareous fine to coarse SAND. Gravel is fine to medium and subangular to subrounded, mainly limestone.* 8.30 - 8.35 w. shell fragments 9.00 - 9.50 very gravelly	Chalk
12.0	-35.6	*Weak to moderate weak, medium to high density, white CHALK. Extremely to closely spaced, closed or clean fractures. (CIRIA A3/A5, medium to high density)*	Chalk
		Very weak to weak, low to medium density CHALK. Closely to medium spaced, closed or clean fractures. (CIRIA A2/A3, low to medium density)	
14.1	-37.7	*Very weak, low density, white CHALK. Medium spaced, open or infilled fractures. (CIRIA B2, low density)* 12.10 - 12.20 w. vertical fracture 12.30 - 12.40 w. vertical infilled fracture	Chalk
15.0	-38.6	*Very weak, low density, white CHALK. Medium to widely spaced, closed or clean fractures. (CIRIA A1/A2, low density)*	

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Dry
Dry rotary drilling	1-TW	0	1.1D	0.10					
			1.2D						
			1.3D	0.50					
			1.4D						
	2-TW	1	2.1U	1.00-1.85					
	3-TW	2	3.1U	2.00-2.80					
	4-TW	3	4.1D	3.00					
			4.2D	3.20					
			4.3D	3.40					
			4.4D	3.50					
			4.5D						
	5-TW	4	5.1D	4.20					
			5.2D	4.40-4.60				2.29	2.02
			5.3D						
			5.4U						
Geobor-S	6-C	5	6.1D	5.20	47			2.45	2.10
			6.2D	5.50					
			6.3D						
			6.4D						
		6							
	7-C		7.1U	6.50-7.20	93				
		7							
	8-C		8.1D	7.30	33				
	9-TW	8	9.1D	8.00					
			9.2D						
			9.3D						
Dry rotary drilling	10-B								
	11-LB	9	11.1D	9.25					
	12-TW	10	12.1D	10.15					
			12.2D	10.35-10.55					
			12.3D						
			12.4U	10.65					
			12.5D						
	13-TW	11	13.1U	11.30-11.55					
	14-TW	12	14.1D	12.30					
			14.2D						
			14.3D	12.65-12.90					
			14.4D						
	15-TW	13	14.5U	13.10-13.95					
			15.1U						
	16-TW	14							
			16.1U	14.50-14.75					
		15							
		16							
		17							
		18							
		19							
		20							
		21							
		22							
		23							
		24							
		25							
		26							
		27							

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

2 4 6 8 PCPT Tip Resistance (MPa)

20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH18	Drilled: LNP/TA	Date: 2013-08-02	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: LTR/ULG	Date: 2013-08-02	Encl No.: 1.1D.ST13467-BH18		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1		

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 07:49

BH Log: ST13467-BH19

Coordinates (m): E: 392,048.4 N: 5,901,769.2 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.3

Drill tool | CPT stroke | Sample no. and type | Depth (m) | Lab specimen: No. and type, Depth | Boundary (m): Depth, Elevation | Graphic Log | Geology: Description of *layers* and details, Formation | Core Runs and Core Quality: TCR (%), SCR (%), RQD (%) | Density (Mg/m³): Bulk, Dry

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Description of *layers* and details	Formation	TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
	1-TW	0	1.1U	0.00-0.70										
		1												

Undrained shear strength
— N_k=12 } Est. from CPT
— N_k=18 }
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution | Gas test | Triax CID | Triax CAU | Permeability | Oedometer

Borehole Log: ST13467-BH19	Drilled:	LNP/TA	Date: 2013-08-09	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared:	DO/ULG	Date: 2013-08-20	Encl No.: 1.1D.ST13467-BH19	
Remarks:	Checked:	ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved:	CLB	Date: 2014-01-28	Page: 1 / 1	

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 07:52

BH Log: ST13467-BH19A

Coordinates (m): E: 392,049.7 N: 5,901,772.7 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.4

Drill tool: Dry rotary drilling; Geobor-S

CPT stroke / Sample no. and type

Depth (m)

Lab specimen: No. and type / Depth

Boundary (m): Depth / Elevation

Graphic Log

Geology

Description of *layers* and details

Formation

Core Runs and Core Quality: TCR (%) / SCR (%) / RQD (%)

Density (Mg/m³): Bulk / Dry

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L 10 20 30 40 %

PCPT Tip Resistance (MPa) 2 4 6 8 — 20 40 60 80

Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution / Gas test / Triax CID / Triax CAU / Permeability / Oedometer

Depth	Elevation	Description of *layers* and details	Formation	TCR (%)	SCR (%)	RQD (%)	Bulk	Dry
0.2	-21.5	*Very loose, dark greyish brown, sl. organic, calcareous, silty, clayey, sl. gravelly, fine to medium SAND. Gravel is fine to medium and subangular, mainly limestone, w. few shell fragments*	Seabed / BB up					
2.0	-23.4	*Firm, dark greyish brown, sandy, sl. gravelly, silty, calcareous CLAY. Gravel is fine to medium and subangular, mainly limestone* 0.30 - 0.40 very loose, very dark grey, organic sand, w. smell of H2S 1.00 - 1.50 gravel is subangular to rounded, w. few thin sand layers	BB up					
4.0	-25.4	*Firm to stiff, dark greyish brown, sl. sandy, sl. gravelly, silty, calcareous CLAY. Gravel is fine to medium and subangular, mainly limestone* 2.00 sand layer	BB up				2.16	1.89
5.4	-26.8	*Stiff, dark greyish brown, sandy, sl. gravelly, silty, calcareous CLAY. Gravel is fine to medium and subangular, mainly limestone* 5.00 - 5.40 firm, gravel is fine to coarse	BB lo				2.22	1.92
9.6	-30.9	*Stiff, dark greyish brown, sl. sandy, sl. gravelly, silty, calcareous CLAY. Gravel is fine to medium and subangular, mainly limestone*		57				
9.7	-31.0	*Compacted, light brownish grey, sandy, clayey, gravelly SILT. Gravel is fine to coarse and subangular, mainly limestone*	BB lo / Chalk	100			2.33	2.00
11.1	-32.4	*Very weak, low density, white CHALK. Matrix composed of uncompacted muddy chalk, clasts are very weak, low density, white chalk (CIRIA Dm, low density)* 9.85 - 9.95 black flint nodule 100x90mm	Chalk	80	0	0		
11.6	-33.0	*Very weak, low density, white CHALK. Extremely closely to closely spaced, closed or clean fractures, w. few greyish marl burrows (CIRIA A5/A4)*	Chalk	90	37	0		
12.1	-33.5	*Very weak, low density, white CHALK. Matrix composed of uncompacted muddy chalk, clasts are very weak, low density, white chalk (CIRIA Dm, low density)*					2.06	1.63

Lab specimen	Depth
1A-TW	0
1A.1D	0.10
1A.2D	
1A.3D	0.35
1A.4D	0.50
1A.5D	
2-TW	1
1A.6D	1.00-1.50
1A.7D	
2.1U	
3-TW	2
3.1U	2.00-2.75
4-TW	3
4.1D	3.10
4.2D	3.30-3.50
4.3D	
4.4U	
5-TW	4
5.1D	4.10
5.2D	4.25-4.45
6-B	
5.3D	
5.4U	
7-TW	5
7.1D	5.10
7.2D	
7.3D	
8-TW	6
8.1U	6.00-6.85
9-TW	7
9.1U	7.00-7.90
10-C	
8	
10.1U	8.00-8.20
11-C	
11.1D	8.70
11.2D	
12-C	9
11.3D	
10	
12.1D	10.00
12.2D	
12.3D	
13-C	
12.4D	
11	
13.1D	11.40
13.2D	
13.3D	
13.4D	12

Borehole Log: ST13467-BH19A	Drilled:	LNP/TA	Date:	2013-08-09	Report No.: 1.1
Project: 36685 Dudgeon	Prepared:	DO/ULG	Date:	2013-08-09	Encl No.: 1.1D.ST13467-BH19A
Remarks:	Checked:	ABP/NKA	Date:	2014-01-28	Rev : 1
	Approved:	CLB	Date:	2014-01-28	Page: 1 / 1

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 07:54

BH Log: ST13467-BH20

Coordinates (m): E: 393,582 N: 5,900,518.7 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -24.8

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Dry rotary drilling	1-TW	0	1.1D	0.10	0.2	-24.9		*Loose, dark greyish brown, gravelly, medium SAND. w. shell fragments, gravel is fine and subangular*	Seabed BB up					
			1.6D	0.10-0.35										
			1.2D	0.40										
			1.3D	0.65-0.85										
			1.4D		1.0	-25.8		*Soft to firm, dark brown, silty, sandy, gravelly, calcareous CLAY. Gravel is mostly subangular chalk pieces of fine size*	BB up				2.14	1.78
	2-TW	1	1.5D	1.00-1.70										
			2.1U					*Firm to stiff, dark brown, silty, sandy, gravelly, calcareous CLAY. Gravel is subangular and medium*						
	3-TW	2	3.1U	2.00-2.80										
					3.0	-27.8								
	4-TW	3	4.1D	3.20				*Stiff, dark brown, silty, sandy, gravelly, calcareous CLAY. Gravel is subangular and medium*	BB up					
			4.2D	3.35-3.55									2.14	1.81
			4.3D											
			4.4U											
	5-TW	4	5.1D	4.30										
			5.2D	4.50-4.65										
			5.3D	4.65-4.90										
			5.4U		5.0	-29.8								
Geobor-S	6-TW	5	5.5U	5.00-5.80				*Stiff, dark brown, silty, sandy, gravelly, calcareous CLAY. Gravel is subangular and medium*	BB lo	47			2.22	1.88
	7-C		6.1U	5.20										
			7.1D	5.50-5.65										
			7.2D	5.65-5.85										
			7.3D											
		6	7.4U											
			7.5U											
	8-C		8.1U	6.50-6.90						27				
		7												
	9-C	8	9.1U	8.00-8.50	8.0	-32.8								
					8.3	-33.0		*Coarse GRAVEL and COBBLES*	Lag	67	0	0		
	10-C		10.1U	8.75-8.85				*Very weak, low density, very light brown CHALK. Matrix composed of uncompacted muddy chalk, clasts are very weak, low density, very light brown chalk (CIRIA Dm, low density)* 8.75 - 8.85 black flint gravel/cobbles	Chalk					
	11-C	9								7	0	0		
		10	11.1D	10.00										
			11.2D											
			11.3D											
			11.4D		10.4	-35.2				100	0	0		
		11												
		12												
		13												
		14												
		15												
		16												
		17												
		18												
		19												
		20												
		21												
		22												

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

2 4 6 8 PCPT Tip Resistance (MPa)

20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH20	Drilled: LNP/TA	Date: 2013-08-10	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: DO/ULG	Date: 2013-08-10	Encl No.: 1.1D.ST13467-BH20		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1		

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 07:57

BH Log: ST13467-BH21

Coordinates (m): E: 388,971.6 N: 5,904,258.2 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -19.1

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Dry rotary drilling	1-TW	0	1.1D	0.10										
	1A-B		1.2D		0.5	-19.5		*Loose, brown to yellowish brown, gravelly, calcareous, medium, organic SAND. w. shell fragments, dark brown layer* 0.30 - 0.45 very dark grey, silty, clayey	Channel					
			1.3D											
			1.4D	0.60 0.70-0.90					Channel				1.46	0.89
	2-LB	1	1.5D											
			1.6D	1.10	1.5	-20.6		*Very soft, very dark grey, organic, sl. calcareous CLAY. Gravel at bottom, thinly laminated with silt and peat* 1.00 - 1.10 loose, very dark grey, gravelly, sl. calcareous sand, w. shell fragments	Channel				1.29	0.70
			1.7D											
			1.8D	1.60					Channel					
			1.9U	1.70-1.90	1.9	-21.0								
	3-TW	2	2.1D	1.90-2.00	2.0	-21.1			Channel					
			2.2D	2.00-2.90										
			2.3D						Channel					
			2.4U											
			2.5D		3.0	-22.1		*Very soft, dark greyish brown, slightly calcareous, organic CLAY*						
			2.6D					*PEAT*	Channel					
	4-TW	3	2.7D	3.10				*Loose, dark grey, silty, very sandy, clayey, calcareous GRAVEL*						
			2.8U											
			2.9U	3.50										
			3.1U											
			4.1D											
	5-LB	4	4.2D	4.10										
			4.3D		4.4	-23.4		*Loose, dark grey, gravelly, calcareous, coarse to medium SAND. organic layer on top* 3.45 - 3.60 Soft, dark grey, sandy, calcareous silt	Channel					
			4.4D											
			4.5D						Channel					
			5.1D	4.90	5.0	-24.1								
	6-TW	5	5.2D	5.00-5.90				*Soft, dark grey, silty, sl. sandy, calcareous CLAY. Thinly laminated with silt and sand*						
			5.3D											
			5.4D											
			5.5D											
			5.6D											
	7-TW	6	6.1U	6.00-6.80				*Soft, dark greyish brown, calcareous, SILT/CLAY*						
			7.1U											
					7.0	-26.1								
	8-TW	7	8.1D	7.10	7.4	-26.5		*Loose, dark greyish brown, silty, sl. calcareous fine SAND, thinly laminated with clay layers*	BB und					
			8.2D											
			8.3D	7.45-7.65					BB und				2.01	
			8.7U	7.60				*Stiff, dark greyish brown, silty, sl. calareous, CLAY. Occasional thin layers of fine sand* 8.00 - 8.20 loose, dark greyish brown, silty, clayey, sl. calcareous, medium sand 8.20 - 8.55 soft						
			8.4D											
	9-TW	8	8.5D	8.10										
			8.6D	8.30										
			9.1D											
			9.2D	8.60-8.80										
			9.3D		9.0	-28.1								
	10-TW	9	9.4D	9.00-9.90				*Soft to firm, dark greyish brown, silty, sandy, sl. calcareous CLAY*	BB und				2.00	1.50
			9.5U											
			10.1U											
	11-TW	10	11.1U	10.00-10.90										
					11.0	-30.1								
	12-TW	11	12.1D	11.10				*Stiff to firm, very dark greyish brown, sl. silty, calcareous CLAY. Thinly laminated with silty, fine sand layers* 11.50 - 11.55 medium sand layer	BB und					
			12.2D	11.25-11.40									1.99	1.58
			12.3D											
			12.4U		11.9	-31.0								
		12												
		13												
		14												
		15												
		16												
		17												
		18												
		19												
		20												
		21												
		22												
		23												
		24												
		25												
		26												
		27												
		28												
		29												

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

✖ $CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)

— 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH21	Drilled: LNP/TA	Date: 2013-08-08	Report No.: 1.1
Project: 36685 Dudgeon	Prepared: DO/ULG	Date: 2013-08-08	Encl No.: 1.1D.ST13467-BH21
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1
	Approved: CLB	Date: 2014-01-28	Page: 1 / 2

GEO W W W . G E O . D K

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 10:13

BH Log: ST13467-BH21

Coordinates (m): E: 388,971.6 N: 5,904,258.2 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -19.1

Drill tool | CPT stroke / Sample no. and type | Depth (m) | Lab specimen: No. and type, Depth | Boundary (m): Depth, Elevation | Graphic Log | Geology: Description of *layers* and details, Formation | Core Runs and Core Quality: TCR (%), SCR (%), RQD (%) | Density (Mg/m³): Bulk, Dry

Undrained shear strength
— N_k=12 } Est. from CPT
— N_k=18 }
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

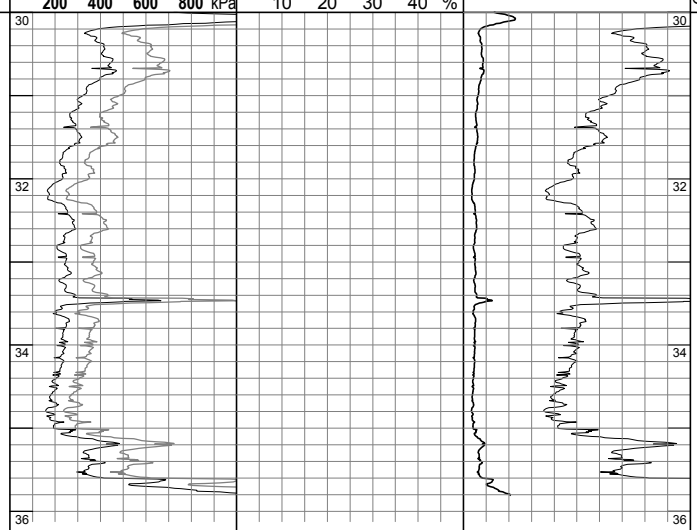
w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution | Gas test | Triax CID | Triax CAU | Permeability | Oedometer



GEO WWW.GEO.DK	Borehole Log: ST13467-BH21	Drilled: LNP/TA	Date: 2013-08-08	Report No.: 1.1	
	Project: 36685 Dudgeon	Prepared: DO/ULG	Date: 2013-08-08	Encl No.: 1.1D.ST13467-BH21	
	Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
		Approved: CLB	Date: 2014-01-28	Page: 2 / 2	

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 10:13

BH Log: ST13467-BH22a

Coordinates (m): E: 390,579.8 N: 5,904,076.9 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.4

Drill tool: Dry rotary drilling; Geobor-S; CPT-A; Geobor-S

CPT stroke / Sample no. and type

Depth (m)

Lab specimen: No. and type / Depth

Boundary (m) Depth	Boundary (m) Elevation	Graphic Log	Description of *layers* and details	Formation	TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³) Bulk	Density (Mg/m³) Dry
0.3	-20.7		*Very Loose, greyish brown, calcareous, gravelly, fine to medium, sl. organic SAND. Gravel is fine to coarse and rounded to subangular, w. plant remains, w. shell fragments*	Seabed / BB up				2.12	1.83
			Stiff, greyish brown, calcareous, gravelly, sandy CLAY. Gravel is fine to coarse and subangular to subrounded, mainly limestones grains						
3.9	-24.3		3.75 - 3.80 greyish brown, gravelly, medium to coarse sandlayer. Gravel is subangular to subrounded, fine to coarse, mainly limestone grains	BB mi	45			2.21	1.92
5.3	-25.6		*Stiff, greyish brown, calcareous, gravelly, sandy CLAY. Gravel is fine to coarse and subangular to subrounded, mainly limestones grains*		61				
5.7	-26.1		3.90 w. 150x80 mm cobble 4.20 w. 30x30 mm granite gravel 4.35 w. 30x40 mm limestone gravel 4.95 w. 20 mm sandlayer 5.10 w. 10 mm sandlayer	BB mi / BB lo	27				
			Very loose, greyish brown, calcareous, gravelly, fine to medium SAND. Gravel is fine to coarse and rounded to subangular, w. many 1-2 mm laminae of clay and silt		19				
			Stiff, greyish brown, calcareous, gravelly, sandy CLAY. Gravel is fine to coarse and subangular to subrounded, mainly limestones grains 9.10 - 9.65 stiff to very stiff		30				
			10.05 w. 50x80 mm gravel		55			2.09	1.81
			10.85 w. 70x60 mm gravel		80			2.23	1.95
12.1	-32.5				0				
12.5	-32.9		*Very dense, greyish brown, calcareous, sl. silty, fine to medium SAND* 12.40 w. cobble 100x70 mm	EG / SB	73				
15.1	-35.5		*Very stiff to hard, light grey, very calcareous, gravelly, sandy, silty CLAY. Gravel is fine to medium and subangular to subrounded* 12.90 w. black flint nodule 100x100 mm 13.00 w. black flint nodule 20x30 mm 13.60 - 14.30 dark grey 14.30 w. black flint nodule 20x30 mm		47				

Lab specimen No. and type	Depth
1-TW	0.05
1.1D	
1.2D	
1.3D	0.45
1.4D	0.65-0.90
1.5D	
2-TW / 1.6U	1.00-1.50
2.1U	
3-TW / 3.1U	2.00-2.50
4-B	
5-TW	
5.1D	3.30
5.2D	3.55-3.80
5.3D	
5.4U	
6-C	
7-TW / 7.1D	5.00
7.2D	
7.3D	5.35
7.4D	
8-C / 7.5D	5.80
9-C / 8.1D	
8.2D	
8.3D	
8.4D	
10-C / 10.1D	7.80
10.2D	
10.3D	
10.4D	
11-C	
11.1D	9.40
11.2D	
11.3D	
11.4D	
12-C / 12.1U	10.20-10.45
13-C / 13.1D	12.20
13.2D	
13.3D	
13.4D	12.80
13.5D	
13.6D	
13.7D	
14-C / 14.1U	13.60-14.05

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

PCPT Tip Resistance (MPa) 2 4 6 8 — 20 40 60 80

Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH22a	Drilled: LNP/TA	Date: 2013-08-03	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: LTR/ULG	Date: 2013-08-03	Encl No.: 1.1D.ST13467-BH22a		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1		

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 08:02

BH Log: ST13467-BH22b

Coordinates (m): E: 390,579.8 N: 5,904,076.9 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.4

Drill tool: Dry rotary drilling; Geobor-S; CPT-A; Geobor-S

CPT stroke / Sample no. and type / Depth (m) / Lab specimen (No. and type, Depth)

Boundary (m) Depth	Boundary (m) Elevation	Graphic Log	Description of *layers* and details	Formation	TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³) Bulk	Density (Mg/m³) Dry
0.3	-20.7		*Very Loose, greyish brown, calcareous, gravelly, fine to medium, sl. organic SAND. Gravel is fine to coarse and rounded to subangular, w. plant remains, w. shell fragments*	Seabed / BB up					
			Stiff, greyish brown, calcareous, gravelly, sandy CLAY. Gravel is fine to coarse and subangular to subrounded, mainly limestones grains					2.12	1.83
3.9	-24.3		3.75 - 3.80 greyish brown, gravelly, medium to coarse sandlayer. Gravel is subangular to subrounded, fine to coarse, mainly limestone grains	BB mi	45			2.21	1.92
5.3	-25.6		*Stiff, greyish brown, calcareous, gravelly, sandy CLAY. Gravel is fine to coarse and subangular to subrounded, mainly limestones grains* 3.90 w. 150x80 mm cobble 4.20 w. 30x30 mm granite gravel 4.35 w. 30x40 mm limestone gravel 4.95 w. 20 mm sandlayer 5.10 w. 10 mm sandlayer	BB mi	61 27				
5.7	-26.1		*Very loose, greyish brown, calcareous, gravelly, fine to medium SAND. Gravel is fine to coarse and rounded to subangular, w. many 1-2 mm laminae of clay and silt*	BB lo	19				
			Stiff, greyish brown, calcareous, gravelly, sandy CLAY. Gravel is fine to coarse and subangular to subrounded, mainly limestones grains 9.10 - 9.65 stiff to very stiff 10.05 w. 50x80 mm gravel 10.85 w. 70x60 mm gravel		30 55 80 0			2.09 2.23	1.81 1.95
12.1	-32.5								
12.5	-32.9		*Very dense, greyish brown, calcareous, sl. silty, fine to medium SAND* 12.40 w. cobble 100x70 mm	EG / SB	73				
			Very stiff to hard, light grey, very calcareous, gravelly, sandy, silty CLAY. Gravel is fine to medium and subangular to subrounded 12.90 w. black flint nodule 100x100 mm 13.00 w. black flint nodule 20x30 mm 13.60 - 14.30 dark grey 14.30 w. black flint nodule 20x30 mm		47				
15.1	-35.5								

Lab specimen:

No. and type	Depth
1.1D	0.05
1.2D	
1.3D	0.45
1.4D	0.65-0.90
1.5D	
1.6U	1.00-1.50
2.1U	
3.1U	2.00-2.50
4-B	
5.1D	3.30
5.2D	3.55-3.80
5.3D	
5.4U	
7.1D	5.00
7.2D	
7.3D	5.35
7.4D	
7.5D	5.80
8.1D	
8.2D	
8.3D	
8.4D	
10.1D	7.80
10.2D	
10.3D	
10.4D	
11.1D	9.40
11.2D	
11.3D	
11.4D	
12.1U	10.20-10.45
13.1D	12.20
13.2D	
13.3D	
13.4D	12.80
13.5D	
13.6D	
13.7D	
14.1U	13.60-14.05

Undrained shear strength: N_k=12, N_k=18 } Est. from CPT

△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

PCPT Tip Resistance (MPa) 2 4 6 8 — 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

GEO www.geo.dk	Borehole Log: ST13467-BH22b	Drilled: LNP/TA	Date: 2013-08-03	Report No.: 1.1	
	Project: 36685 Dudgeon	Prepared: LTR/ULG	Date: 2013-08-03	Encl No.: 1.1D.ST13467-BH22b	
	Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
		Approved: CLB	Date: 2014-01-28	Page: 1 / 1	

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 08:05

BH Log: ST13467-BH23

Coordinates (m): E: 392,973.1 N: 5,903,271.2 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -22.0

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Dry rotary drilling	1-TW	0	1.1U	0.00-0.85				*Stiff, dark greyish brown, sandy, silty, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, mainly limestones*	BB und					
	2-TW	1	2.1D 2.2D 2.3D	1.20				0.00 w. pale brown, sl. calcareous, fine to medium sand layer						
	3-TW	2	3.1U	2.00-2.70				1.00 - 1.10 w. pale brown, calcareous, fine to medium sand layer, w. few shell fragments						
	4-TW	3	4.1D 4.2D 4.3D 4.4U	3.20 3.45-3.70										
		4			4.0	-26.0							2.19	1.88
	5-TW	4	5.1U 5.2D 5.3D 5.4D	4.10-4.30 4.40				*Firm to stiff, dark greyish brown, sandy, silty, sl. gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, mainly limestones*	BB und				2.15	1.83
	6-TW	5	6.1U	5.00-5.65				4.40 - 4.50 fine sand, clay laminae, thinly to thickly laminated						
	7-TW	6	7.1U	6.00-6.70										
		7			7.0	-29.0								
	8-TW	7	8.1D 8.2D 8.3D 8.4U	7.20 7.35-7.55				*Firm to stiff, dark greyish brown, sl. sandy, silty, sl. gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded, mainly limestones*	BB und				2.15	1.82
	9-TW	8			8.2	-30.2		*Hard, light brownish grey, very sandy, gravelly, very calcareous CLAY. Gravel is fine and subangular*	BB und					
		9			9.5	-31.5								
Geobor-S	10-TW 11-C	10	10.1U 11.1D 11.2D 11.3D 11.4U	9.50-9.95 9.60 9.75-9.95				*Stiff to hard, dark grey, clayey, very sandy, gravelly, very calcareous SILT*	EG	85			2.37	2.26
					10.7	-32.7								
	12-C				10.8	-32.8		*Coarse GRAVEL, angular to subangular*	Lag	37	20	13	1.80	1.46
		11	12.1U	10.90-11.05				*Moderatly weak, medium density, white CHALK. Extremely closely spaced, closed or clean fractures (CIRIA A5, medium density)*	Chalk					
					12.0	-34.0		*Very weak, low density, white CHALK. Matrix composed of uncompacted muddy chalk. clasts are very weak, low density white chalk, with 5-50mm flint stones (CIRIA Dm, low density)*	Chalk	87	0	0		
	13-C	12	13.1D 13.2D 13.3D	12.30 12.80	12.8	-34.8			Chalk	60	50	33		
	14-C	13	13.4D 13.5D 14.1D 14.2D 14.3D 14.4D	12.90-13.10				*Very weak, low density, white CHALK. Extremely closely to closely spaced, closed or clean fractures (CIRIA A5, medium density)*					2.08	1.60
		14	14.5U							100	60	43		
	15-C	15	15.1D 15.2D 15.3D 15.4D 15.5U	14.50 15.15-15.35										
					15.8	-37.8		15.70 - 15.75 w. black flint nodules 100x60mm						

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

2 4 6 8 PCPT Tip Resistance (MPa)

20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH23	Drilled:	LNP/TA	Date:	2013-08-08	Report No.: 1.1
Project: 36685 Dudgeon	Prepared:	DO/ULG	Date:	2013-08-08	Encl No.: 1.1D.ST13467-BH23
Remarks:	Checked:	ABP/NKA	Date:	2014-01-28	Rev : 1
	Approved:	CLB	Date:	2014-01-28	Page: 1 / 1

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 08:07

BH Log: ST13467-BH24

Coordinates (m): E: 389,974.8 N: 5,906,936.1 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -30.7

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Dry rotary drilling	1-TW	0	1.1U	0.00-0.55				*Stiff, dark greyish brown, sandy, silty, gravelly, calcareous CLAY. Gravel is fine to medium and subrounded to subangular, mainly limestone*						
	2-TW	1	2.1U	1.00-1.20				0.00 loose, pale brown sand 1.00 - 1.25 loose, silty, clayey, gravelly, slightly calcareous, medium sand. Gravel is fine to medium and subrounded						
								loose, ravelly silty, slightly calcareous, coarse sand, gravel is angular						
								firm						
								very stiff						
								very stiff						
								very stiff						
					9.2	-39.9		very stiff						
					10.1	-40.8		*Very weak, low density wihte CHALK. Matrix composed of uncompacted muddy chalk, clasts are very weak, low density, white chalk, pieces of flint, fine to coarse (CIRIA Dm, low density)* loose, crushed flint, fine to coarse						

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

PCPT Tip Resistance (MPa) 2 4 6 8 / 20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH24	Drilled: LNP/TA	Date: 2013-08-04	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: DO/ULG	Date: 2013-08-20	Encl No.: 1.1D.ST13467-BH24		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1		

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 08.09

BH Log: ST13467-BH24A

Coordinates (m): E: 389,993.9 N: 5,906,942 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.8

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
	1-TW	0	1.A1U	0.00-0.90				*Very stiff, dark brown, silty, sandy, gravelly, calcareous CLAY. Gravel is subangular and fine, pieces of chalk.*	BB up					
	2-TW	1	2.A2D 2.A3D 2.A4D 2.A5D 2.A1U	1.10 1.25-1.40				1.00 - 1.10 stiff						
	3-TW	2	3.1U 3.2D 3.3D	2.15-2.35 2.30				2.00 - 2.25 stiff 2.35 - 2.40 dark brown, silty, clayey sand.						
	4-TW	3	4.1U	3.00-3.55										
	C 5-TW	4 5	5.1D 5.2D 5.3D 5.4U	4.00 4.25-4.45	4.0	-24.8		*Stiff dark brown, silty, sandy, gravelly, calcareous CLAY. Pieces of chalk, gravel is medium and subrounded*	BB up	0			2.16	1.91
	6-C	6			6.0	-26.8		*Stiff dark brown, silty, sandy, gravelly, calcareous CLAY. Pieces of chalk, gravel is medium and subrounded*	BB lo	40				
	7-C	7	7.1D 7.2D 7.3D	6.80						53				
	8-C		7.4D 8.1U	7.30-7.50						60			2.28	1.99
	9-C	8	9.1D 9.2D 9.3D	8.10				8.50 - 9.45 v. sandy		100				
	10-C	9								90				
	11-C	10	11.1U	9.90-10.15	9.6	-30.4		*Stiff, dark brown, sl. sandy, silty sl. gravelly CLAY. Gravel is fine and subangular, w. silty laminae, thinly laminated <1mm, w. fine sand laminae, thinly laminated <1mm,*	BB lo	75			2.07	1.57
	12-C	11	12.1U	10.85-11.30						75				
	13-C	12	13.4U 13.1D 13.2D 13.3D	12.10-12.30 12.40	11.6	-32.4		*Very stiff, light grey, sandy, gravelly, silty, v. calcareous CLAY, Gravel is fine to medium and subrounded to subangular, mainly limestone*	SB	70			2.31	1.99
	14-C	13			13.1	-33.9		*Hard, light grey, sandy, gravelly, silty, v. calcareous CLAY, Gravel is fine to medium and subrounded to subangular, mainly limestone*	SB	50				
	C	14								0				
	15-C							14.55 - 14.70 gravel is fine to coarse		30				
	16-C	15								100				
	17-C		16.1D 16.2D 16.3D 16.4D	15.40						70				
	18-C	16	18.1U	16.30-16.55						100			2.35	2.09
	19-C		19.1U	16.55-17.55	16.9	-37.7				100				
	20-C	17						*Hard, dark grey, v. sandy, silty, gravelly, v. calcareous CLAY, Gravel is fine to medium and subrounded to subangular*	SB	100				
		18												
	21-C	19	20.1D 20.2D 20.3D 20.4D 21.1U 21.2U	18.50 18.65-18.90 18.90-20.30						100				
		20			20.3	-41.1							2.50	2.28

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

PCPT Tip Resistance (MPa) 2 4 6 8 — 20 40 60 80

Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH24A	Drilled:	LNP/TA	Date: 2013-08-06	Report No.: 1.1	
Project: 36685 Dudgeon	Prepared:	DO/ULG	Date: 2013-08-06	Encl No.: 1.1D.ST13467-BH24A	
Remarks:	Checked:	ABP/NKA	Date: 2014-01-28	Rev : 1	
	Approved:	CLB	Date: 2014-01-28	Page: 1 / 1	

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 08:12

BH Log: ST13467-BH25

Coordinates (m): E: 389,436 N: 5,905,016.9 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -20.5

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary Depth (m)	Boundary Elevation (m)	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Dry rotary drilling	1-TW	0	1.1U	0.00-0.90				*Stiff, dark brown, silty, sandy, gravelly, sl. calcareous CLAY. Gravel is mainly subangular chalk pieces, w. shell fragments on top*	BB up					
					1.0	-21.5								
	2-TW	1	2.1D	1.20				*Stiff, dark brown, silty, sandy, gravelly, calcareous CLAY. Gravel is fine to coarse and subrounded to subangular mainly limestone*	BB up					
			2.2D	1.40-1.55				1.00 - 1.10 very sandy					2.14	1.86
			2.3D											
			2.4U											
	3-TW	2	3.1D	2.20										
			3.2D	2.30-2.45									2.14	1.87
			3.3D	2.50										
			3.4U											
	4-TW	3	3.5D	3.00-3.50				3.00 w. fine to medium sand layer						
			4.1U											
					4.0	-24.5								
Geobor-S	5-TW	4	5.1D	4.10				*Stiff, dark brown, silty, v. sandy, sl. gravelly, calcareous CLAY. Gravel is fine to coarse and subrounded to subangular mainly limestone, w. fine to coarse sand layers*	BB mi	63			2.10	1.82
	6-C		5.2D					4.00 w. cobble 70x50mm						
			5.3D	4.50-4.70										
			5.4U											
	7-C	5			5.2	-25.7		4.85 - 4.90 CLAY is yellowish red	BB lo	50				
			7.1U	5.35-5.95				*Stiff, dark brown, silty, sandy, gravelly, calcareous CLAY. Gravel is fine to coarse and subrounded to subangular*						
		6						5.95 w. cobble 90x60mm		130				
	8-C		8.1U	6.60-6.80										
			8.2D	6.90										
		7	8.3D											
			8.4D											
			8.5D	7.50				7.40 w. cobble 70x30mm					2.11	1.80
	C	8								0				
	9-C									188				
		9								89				
	10-C		10.1U	9.35-9.85										
			11.1D	10.10				10.00 - 10.60 very stiff, gravel is fine to medium		60			2.35	2.03
	11-C	10	11.2D	10.30-10.50										
			11.3D											
			11.4U											
	C	11								0				
	12-C		12.1U	11.50-12.00						200				
	13-C	12								20				
	14-C		14.1D	12.50						190				
	15-C	13	15.1U	13.00-13.50						50				
	16-C	14			14.3	-34.8				100				
	17-C							*Hard, light grey, silty, sandy, gravelly v. calcareous CLAY. Gravel is fine to medium and subangular, mainly limestone*	SB	100				
		15	17.1U	15.10-15.30										
			17.2D	15.50										
	18-C		17.3D	15.60-17.10						100			2.26	1.87
		16	17.4D											
			18.1U					16.40 dark grey						
	19-C	17								107	0	0		
					17.8	-38.3		17.30 w. limestone clast 80x50mm						
			19.1D	18.10				*Very weak, low density, white CHALK, Matrix composed of uncompacted, v. sandy, sl. muddy chalk, clasts are very weak, low density (CIRIA Dc, low density)*	SB					
		18	19.2D											
			19.3D		18.6	-39.1								
	20-C		19.4D	18.60-19.90					SB	87				
			20.1U					*Hard, light grey, silty, sandy, gravelly v. calcareous CLAY. Gravel is fine to medium and subangular, mainly limestone*						
		19												
					19.9	-40.4								
		20												

Undrained shear strength
- N_k=12, N_k=18 } Est. from CPT
- △ Pocket Pen ▲ Tor Vane
- ⊙ Lab Vane ◇ Fall Cone
- ● Intact UU ■ UCS
- ⊗ Rem. Lab vane/Fall cone

200 400 600 800 kPa

$CaCO_3$ 4 8 12 16 %

w_P w w_L

10 20 30 40 %

2 4 6 8 PCPT Tip Resistance (MPa)

20 40 60 80

● Point Load Strength $I_{s\,50}$ 0.1 0.2 0.3 0.4MPa

D_r (Baldi et al.) 30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

Borehole Log: ST13467-BH25	Drilled: LNP/TA	Date: 2013-08-07	Report No.: 1.1		
Project: 36685 Dudgeon	Prepared: DO/ULG	Date: 2013-08-07	Encl No.: 1.1D.ST13467-BH25		
Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1		
	Approved: CLB	Date: 2014-01-28	Page: 1 / 1		

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STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 08:15

BH Log: ST13467-BH26

Coordinates (m): E: 392,820.1 N: 5,905,767.9 Grid & Datum: WGS 84 UTM Zone 31 N - LAT

Notes:

Seabed Level (m): -21.8

Drill tool	CPT stroke / Sample no. and type	Depth (m)	Lab specimen: No. and type	Lab specimen: Depth	Boundary (m): Depth	Boundary (m): Elevation	Graphic Log	Geology: Description of *layers* and details	Formation	Core Runs and Core Quality: TCR (%)	SCR (%)	RQD (%)	Density (Mg/m³): Bulk	Density (Mg/m³): Dry
Dry rotary drilling	1-TW	0	1.1D 1.2D 1.3D 1.4D	0.10	0.4	-22.2		*Very loose, greyish brown, sl. silty, gravelly, sl. organic, sl calcareous, fine to medium SAND. Gravel is fine to coarse and subangular to subrounded* 0.00 - 0.10 w. many shell fragments 0.00 - 0.40 w. two silty, fine, 10mm sand layers 0.20 w. limestone cobble 60x60mm	Seabed BB up					
	2-TW	1	2.1U	1.00-1.70										
	3-TW	2	3.1U	2.00-2.90	2.0	-23.8		*Firm, dark greyish brown, silty, sandy, gravelly, calcareous CLAY. Gravel is fine to coarse and subangular to subrounded* 1.00 - 1.70 sl. sandy sl. gravelly, gravel is fine to medium, mainly limestone	BB up					
	4-TW	3	4.1D 4.2D 4.3D 4.4U	3.10 3.25									2.20	1.94
	5-TW	4	5.1D 5.2D 5.3D 5.4U	4.20 4.35-4.55 4.55-4.80	4.0	-25.8		*Stiff, dark greyish brown, silty, sl. sandy, sl. gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded* 3.00 - 3.50 gravel is fine to coarse	BB up					
Geobor-S	6-TW 7-C	5	5.5U 6.1U 7.1D 7.2D 7.3D 7.4U	5.00-5.60 5.30 5.45-5.70	5.0	-26.8		*Stiff, dark greyish brown, silty, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded* *Stiff, dark greyish brown, silty, sandy, gravelly, calcareous CLAY. Gravel is fine to medium and subangular to subrounded* 5.00 - 5.60 Stiff to very stiff	BB lo	47			2.21 2.34	1.95 2.06
	8-C	6	8.1U	6.50-7.35						61				
	9-C	7	9.1U	7.40-8.35	7.8	-29.6				95	0	0		
	10-C	8						*Very weak, low density, white CHALK. Matrix composed of uncompacted, muddy chalk, clasts are very weak, low density, white chalk, flint stones of 50 mm mixed in between (CIRIA Dm, low density)*	Chalk	100	0	0		
		9	10.1D 10.2D 10.3D 10.4D	8.80	9.9	-31.7								
		10												
		11												
		12												
		13												
		14												

Undrained shear strength
— N_k=12 } Est. from CPT
— N_k=18 }
△ Pocket Pen ▲ Tor Vane
⊙ Lab Vane ◇ Fall Cone
● Intact UU ■ UCS
⊗ Rem. Lab vane/Fall cone
200 400 600 800 kPa

✖ $CaCO_3$
4 8 12 16 %

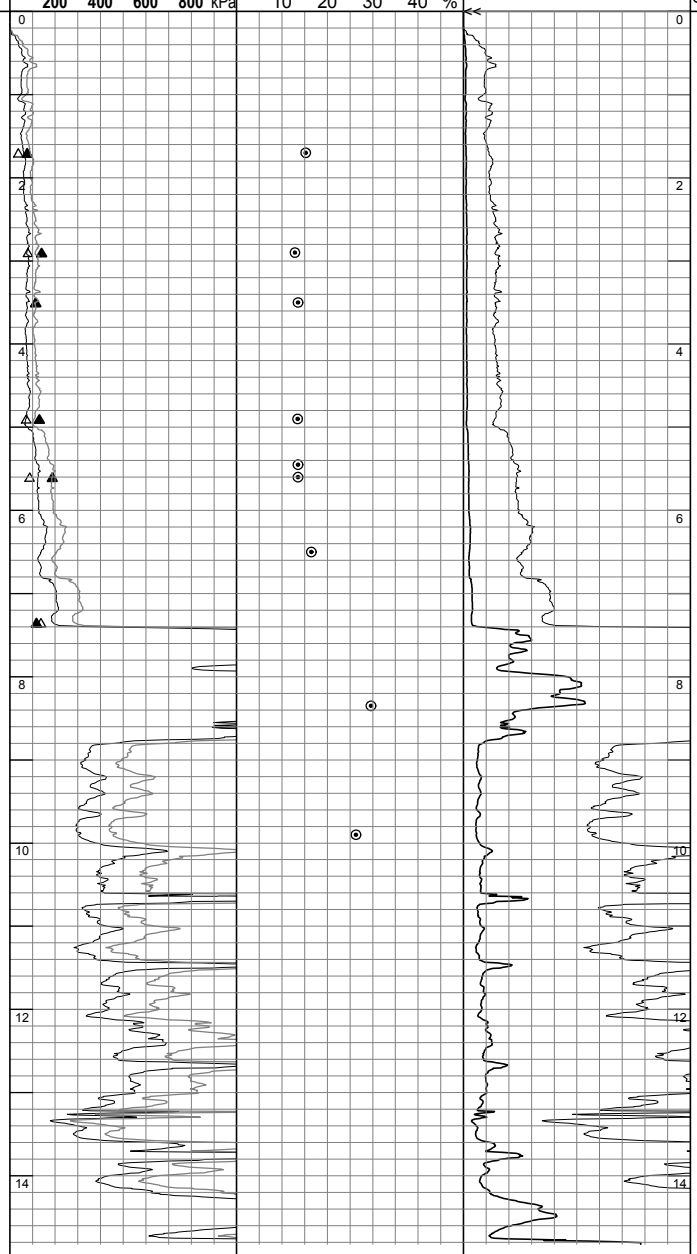
w_P w w_L
10 20 30 40 %

— 2 4 6 8 PCPT Tip Resistance (MPa)
— 20 40 60 80

● Point Load Strength $I_{s\,50}$
0.1 0.2 0.3 0.4MPa

— D_r (Baldi et al.)
30 60 90 120 %

Other Tests: Grain size distribution; Gas test; Triax CID; Triax CAU; Permeability; Oedometer

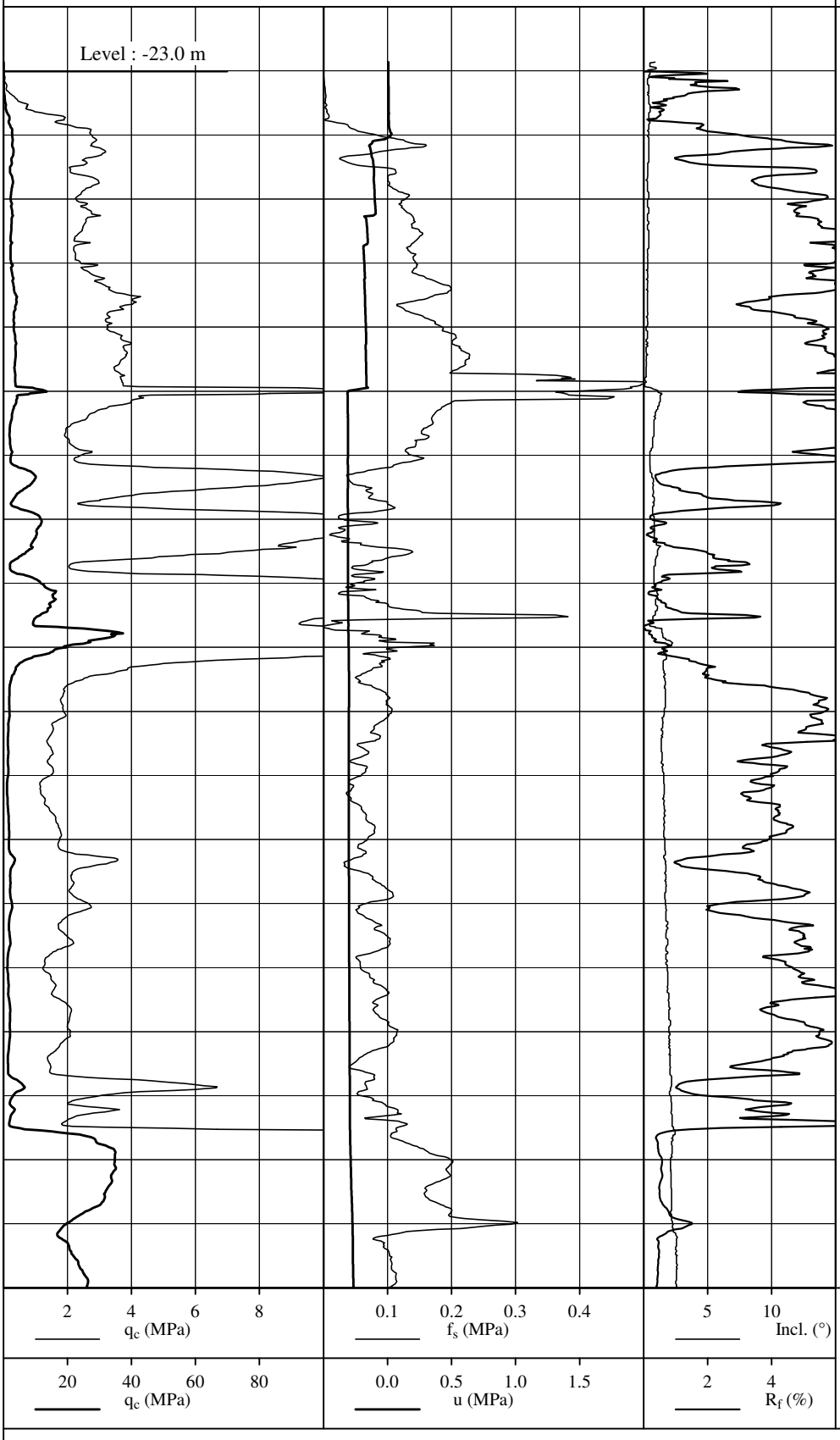


GEO WWW.GEO.DK	Borehole Log: ST13467-BH26	Drilled: LNP/TA	Date: 2013-08-11	Report No.: 1.1	
	Project: 36685 Dudgeon	Prepared: DO/ULG	Date: 2013-08-11	Encl No.: 1.1D.ST13467-BH26	
	Remarks:	Checked: ABP/NKA	Date: 2014-01-28	Rev : 1	
		Approved: CLB	Date: 2014-01-28	Page: 1 / 1	

STATOIL-LOG-A3 / 36685 DUDGEON-1 2013-11-01.GPJ / 2014-02-03 08:18

8 APPENDIX 2: CPT LOGS

CPT name : ST14461-CPT1



E	: 394954.6	Cone no.	: 130811	Rig	: GEOScope
N	: 5897046.2	Cone type	: TSP	Performed by	: LEJ/2014-03-12
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

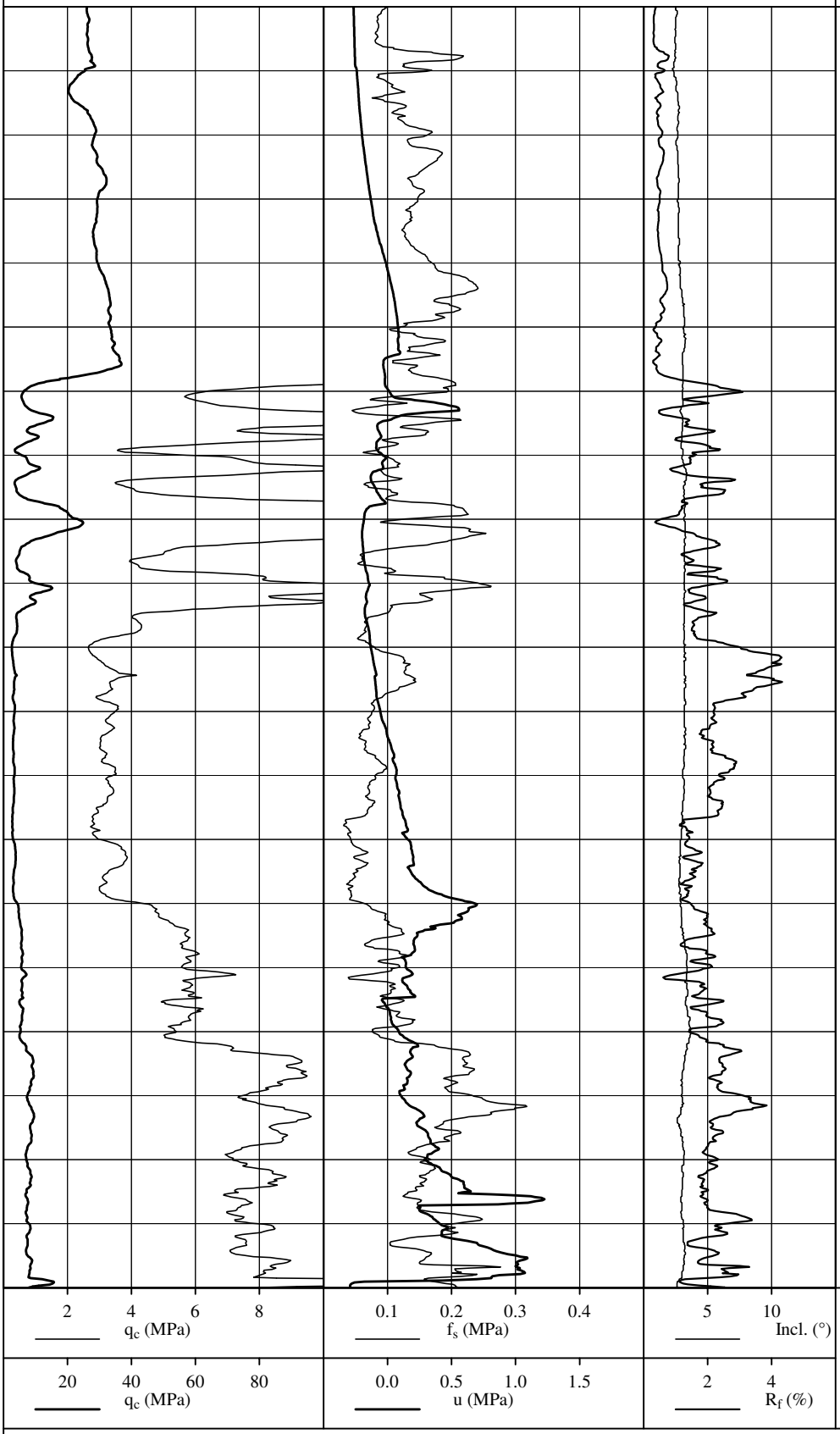
Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: ABP	Date: 2014-03-12	Subject: ST14461-CPT1		
Checked	:	Date: 2014-03-12			Page 1 / 3
Approved	:	Date: 2014-03-12	Report	Enclosure: ST14461-CPT1	Rev.

Perceptor - 1.5.10.102

Printed 2014-03-13 16:13:47

CPT name : ST14461-CPT1

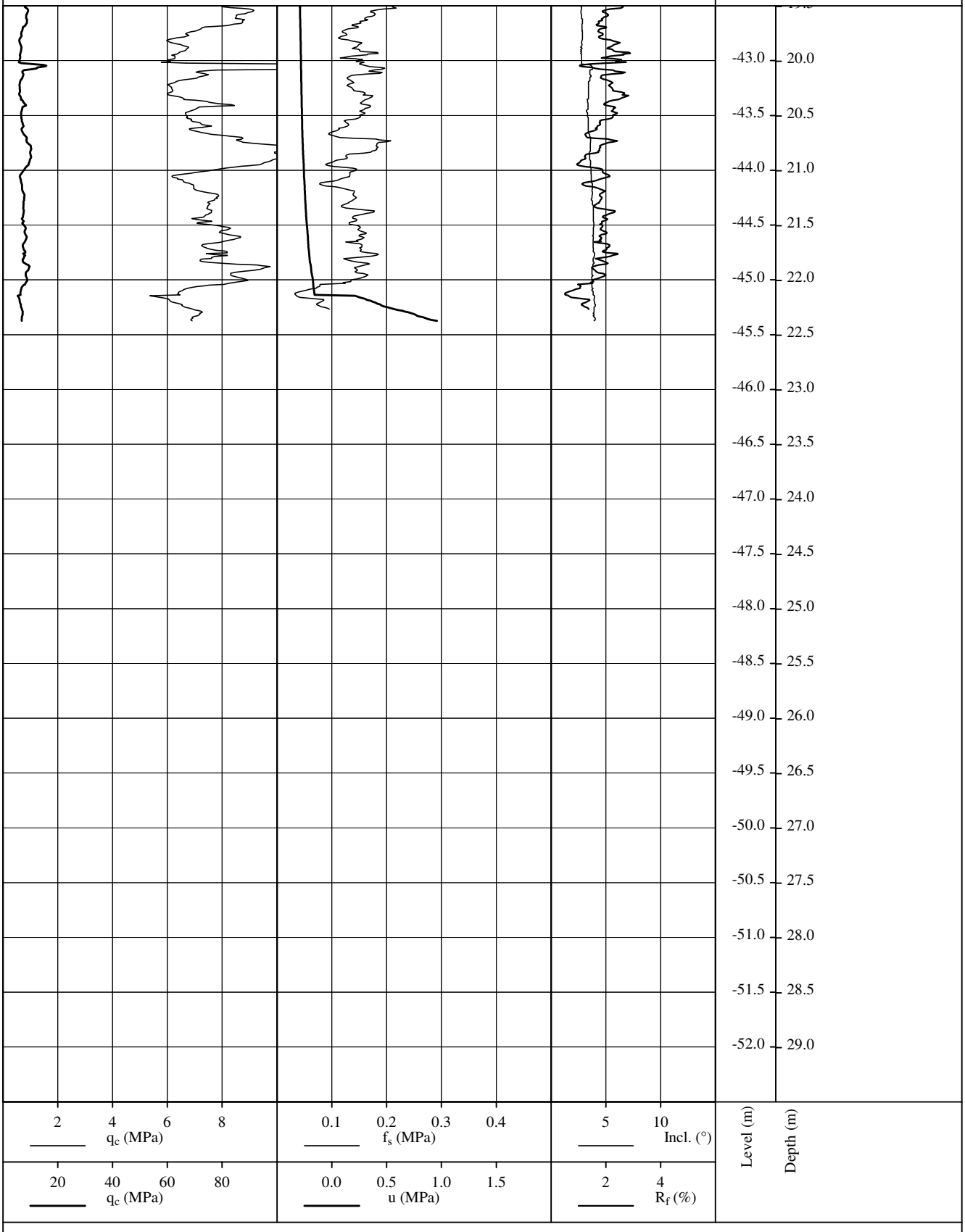


E	: 394954.6	Cone no.	: 130811	Rig	: GEOScope
N	: 5897046.2	Cone type	: TSP	Performed by	: LEJ/2014-03-12
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

GEO Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: ABP	Date: 2014-03-12	Subject: ST14461-CPT1		
Checked	:	Date: 2014-03-12			Page 2 / 3
Approved	:	Date: 2014-03-12	Report	Enclosure: ST14461-CPT1	Rev.

CPT name : ST14461-CPT1



E	: 394954.6	Cone no.	: 130811	Rig	: GEOScope
N	: 5897046.2	Cone type	: TSP	Performed by	: LEJ/2014-03-12
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

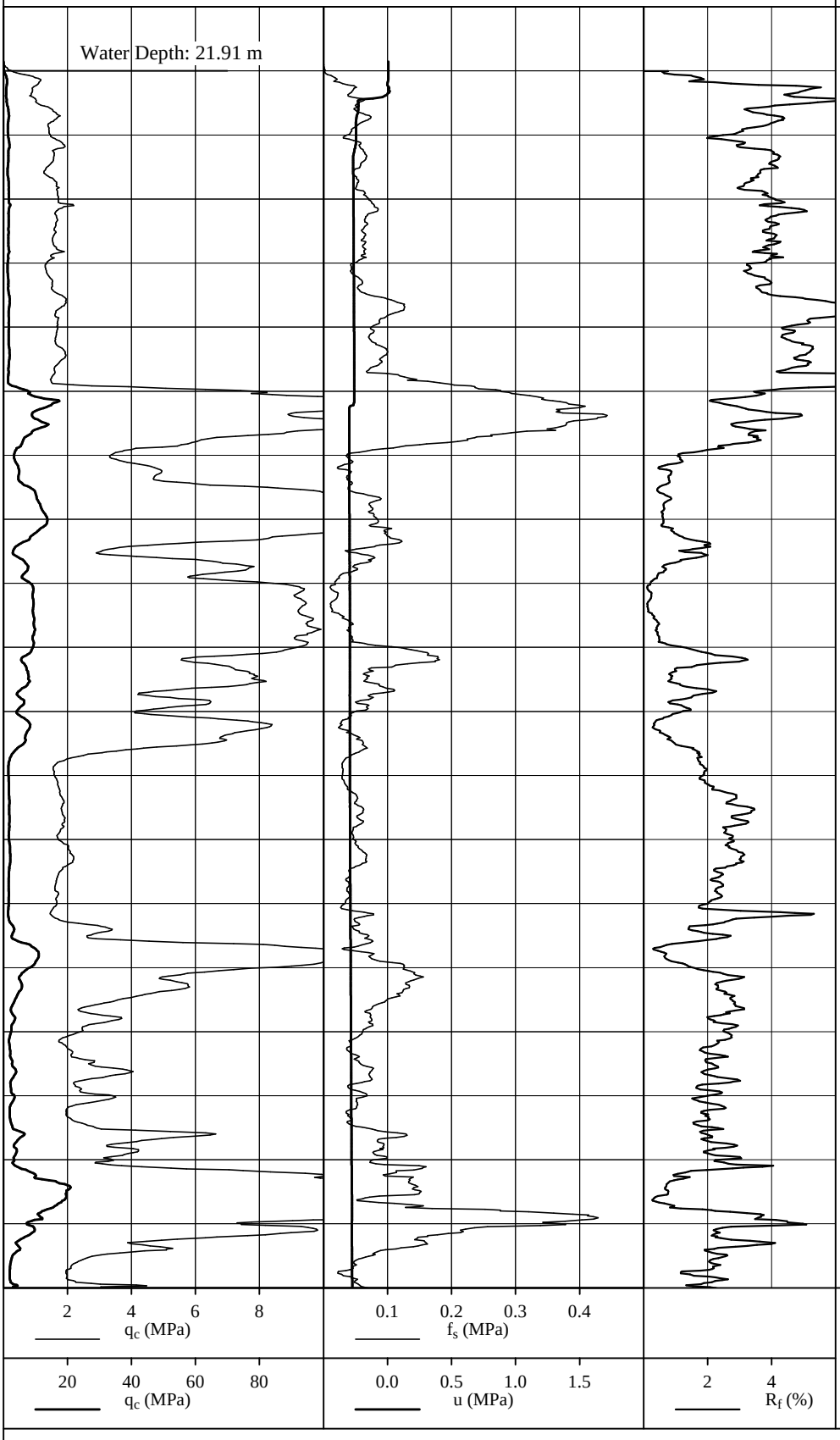
Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: ABP	Date: 2014-03-12	Subject: ST14461-CPT1	
Checked	:	Date: 2014-03-12		Page 3 / 3
Approved	:	Date: 2014-03-12	Report Enclosure: ST14461-CPT1	Rev.

Perceptor - 1.5.10.102

Printed 2014-03-13 16:13:49

CPT name : ST14461-CPT11



E	: 388567,3	Cone no.	: 130811	Rig	: GEOScope
N	: 5902217,7	Cone type	: TSP	Performed by	: BVI/2014-03-13 13:23:48
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: KNM	Date: 2014-03-14	Subject: ST14461-CPT11		
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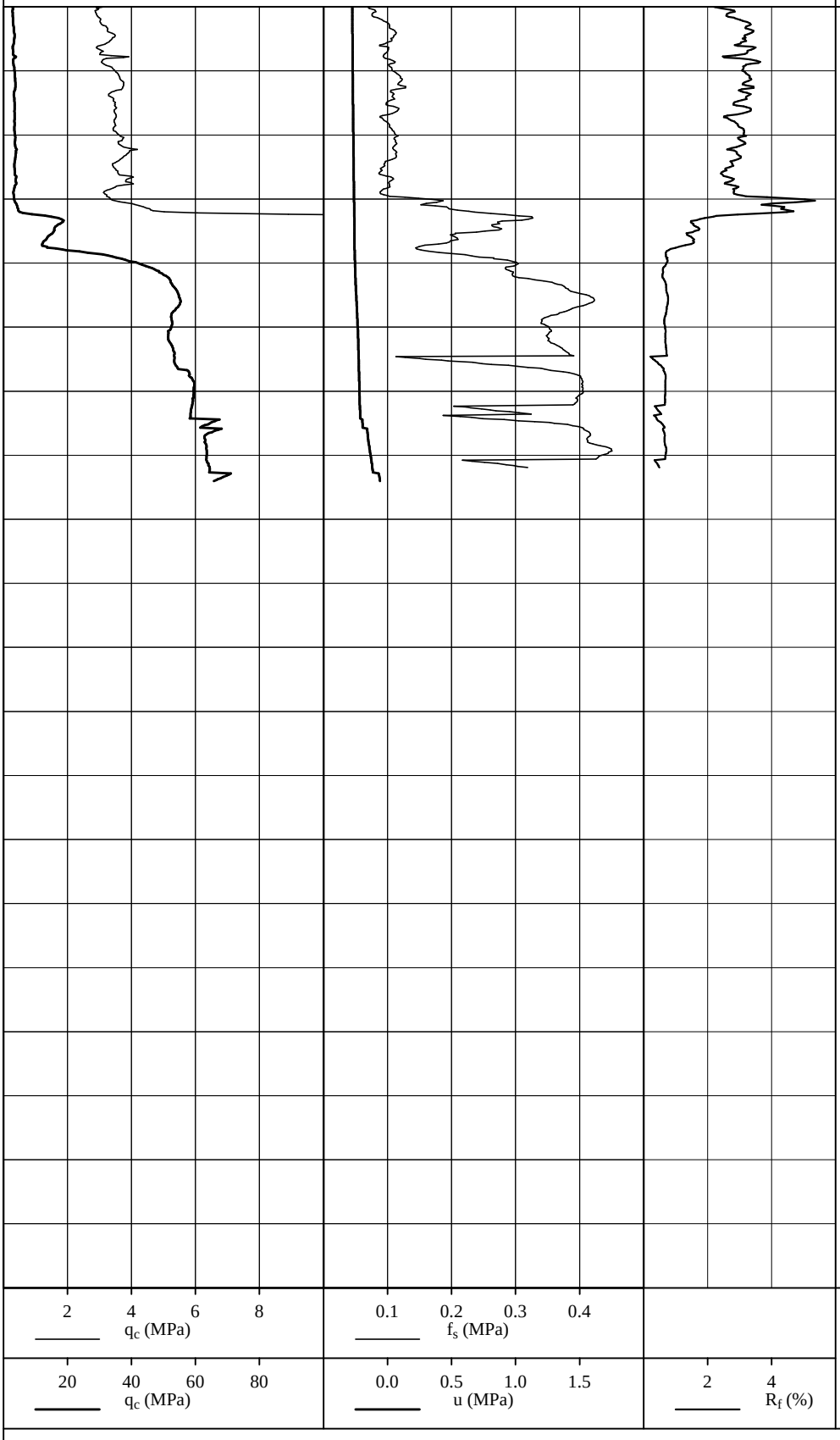
Perceptor - 1.5.10.120

Printed 2014-03-14 03:51:07

CPT name : ST14461-CPT11



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N	: 5902217,7	Cone type	: TSP	Performed by	: BVI/2014-03-13 13:23:48
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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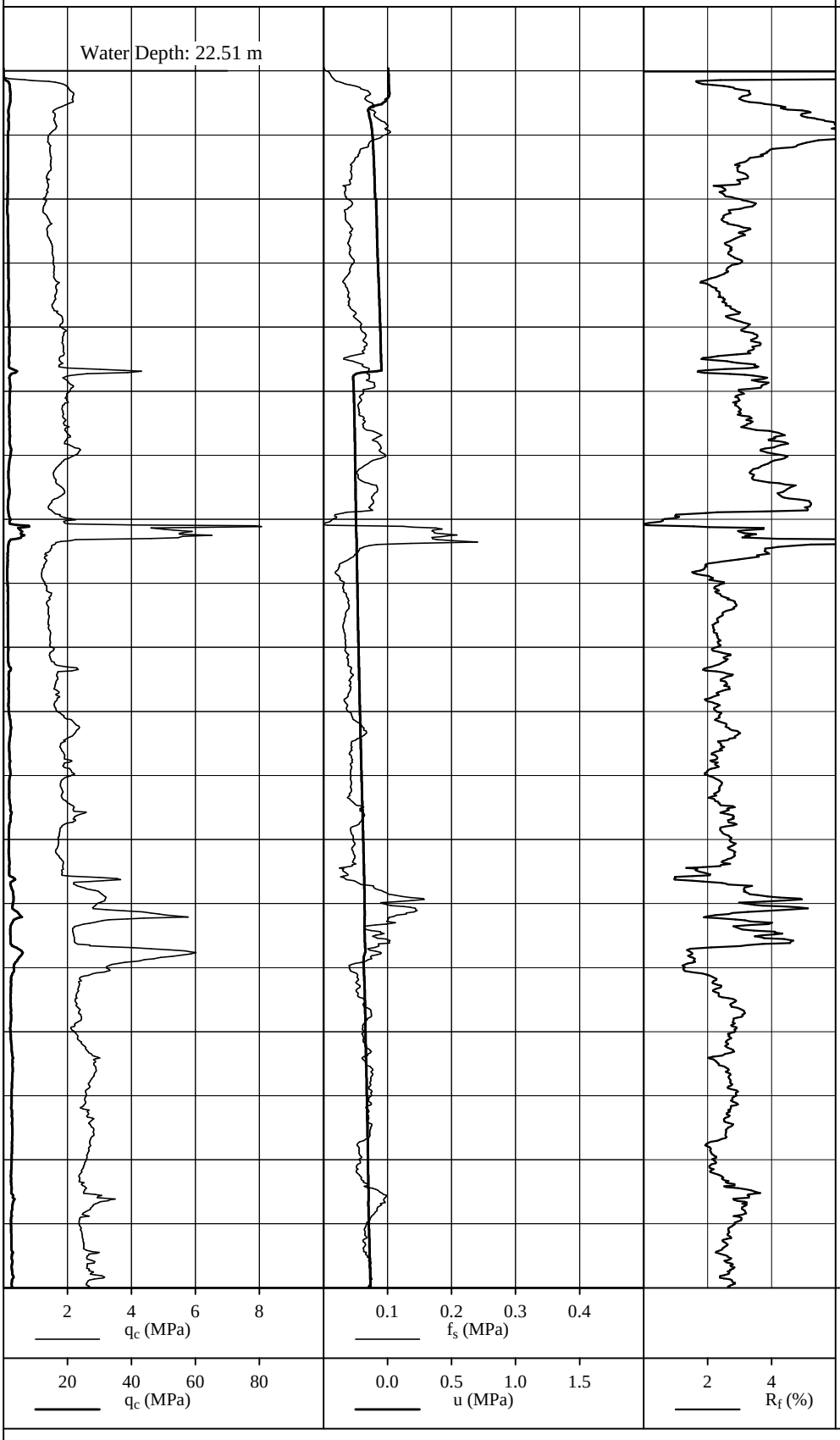
Printed 2014-03-14 03:51:08

CPT name : ST14461-CPT12



E	: 387929,4	Cone no.	: 130811	Rig	: GEOScope
N	: 5902735,1	Cone type	: TSP	Performed by	: BVI/2014-03-13 14:52:59
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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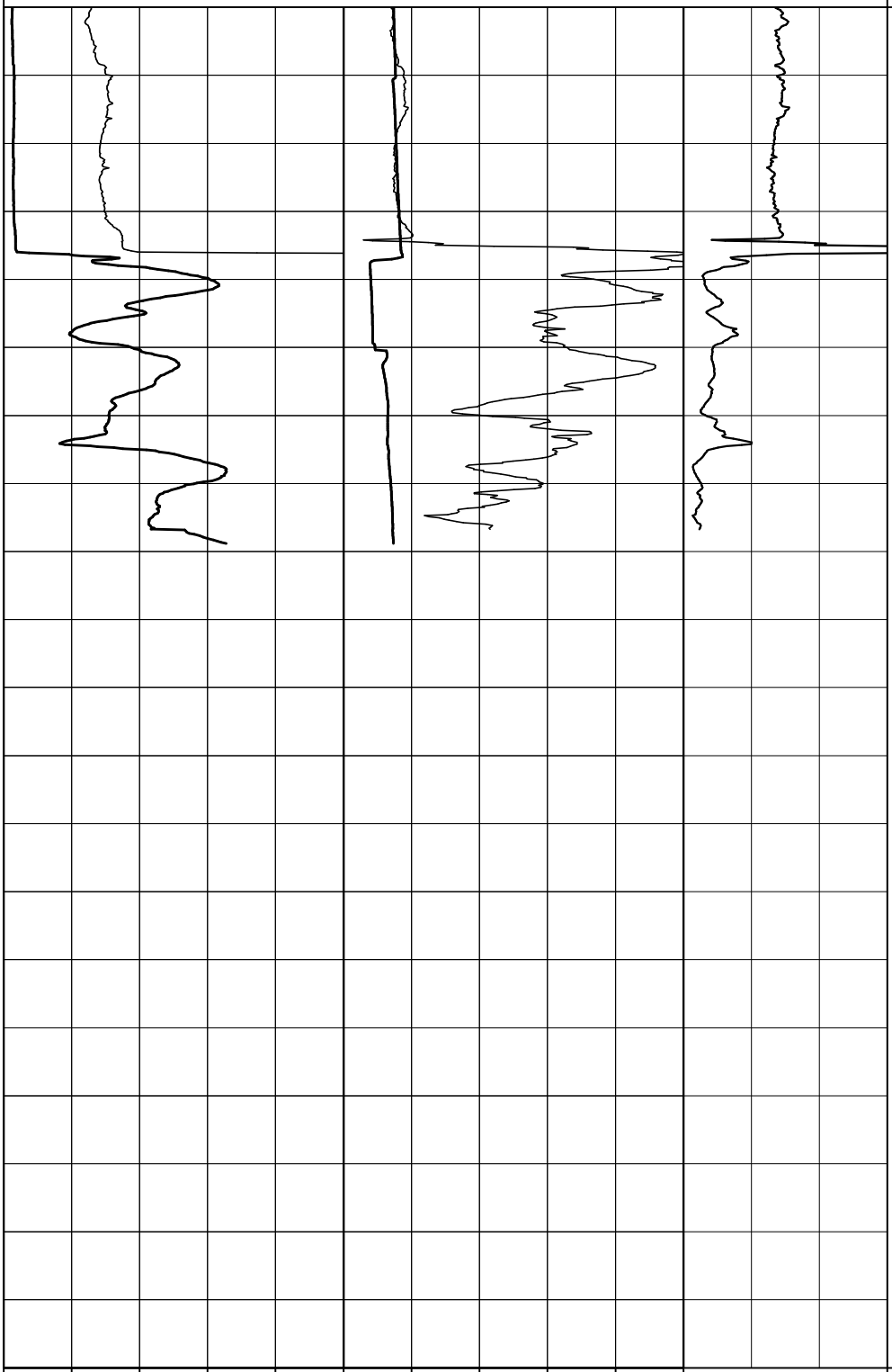
CPT name : ST14461-CPT12



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N	: 5902735,1	Cone type	: TSP	Performed by	: BVI/2014-03-13 14:52:59
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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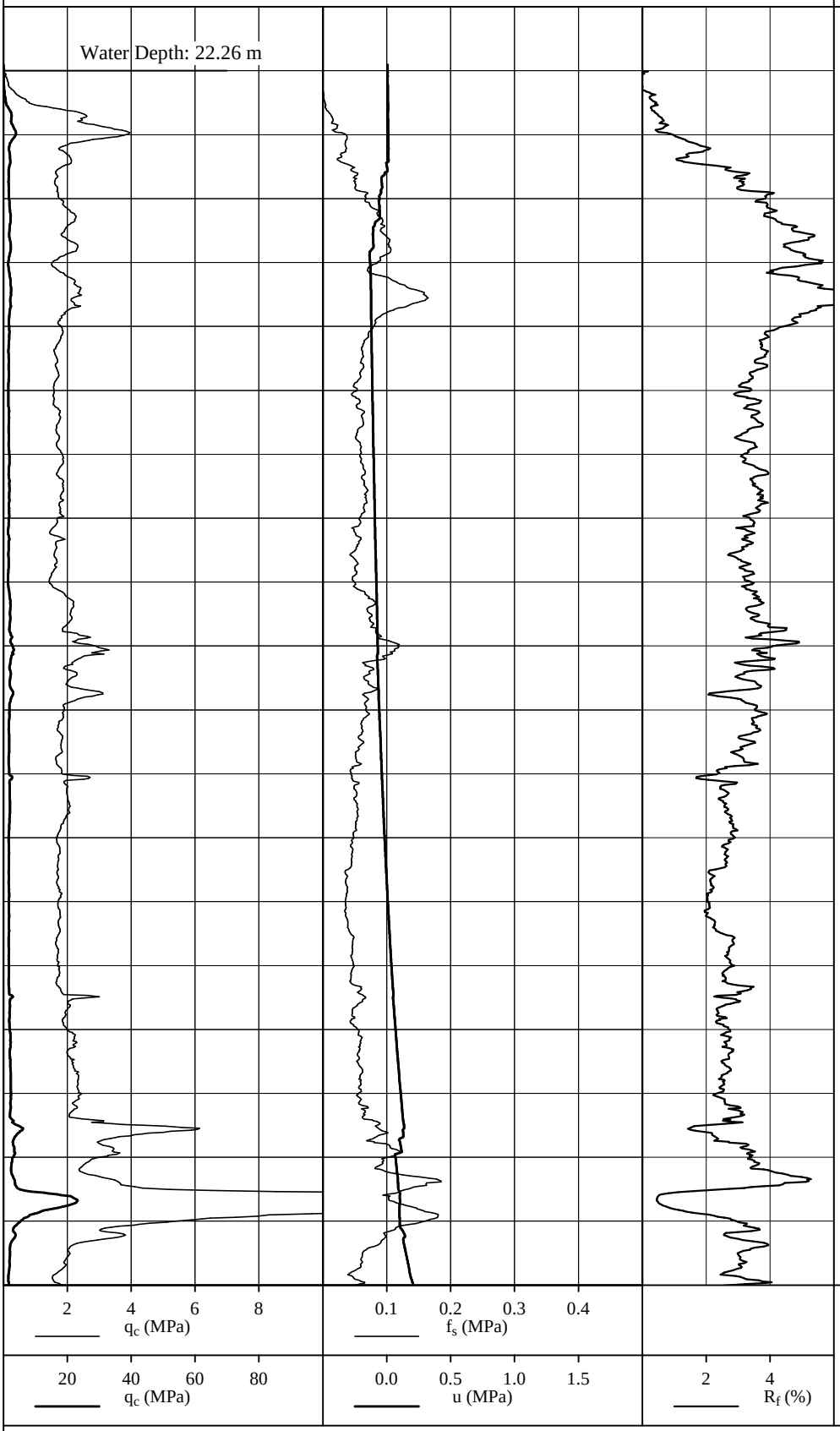
CPT name : ST14461-CPT13



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N	: 5903523,6	Cone type	: TSP	Performed by	: BVI/2014-03-13 16:25:26
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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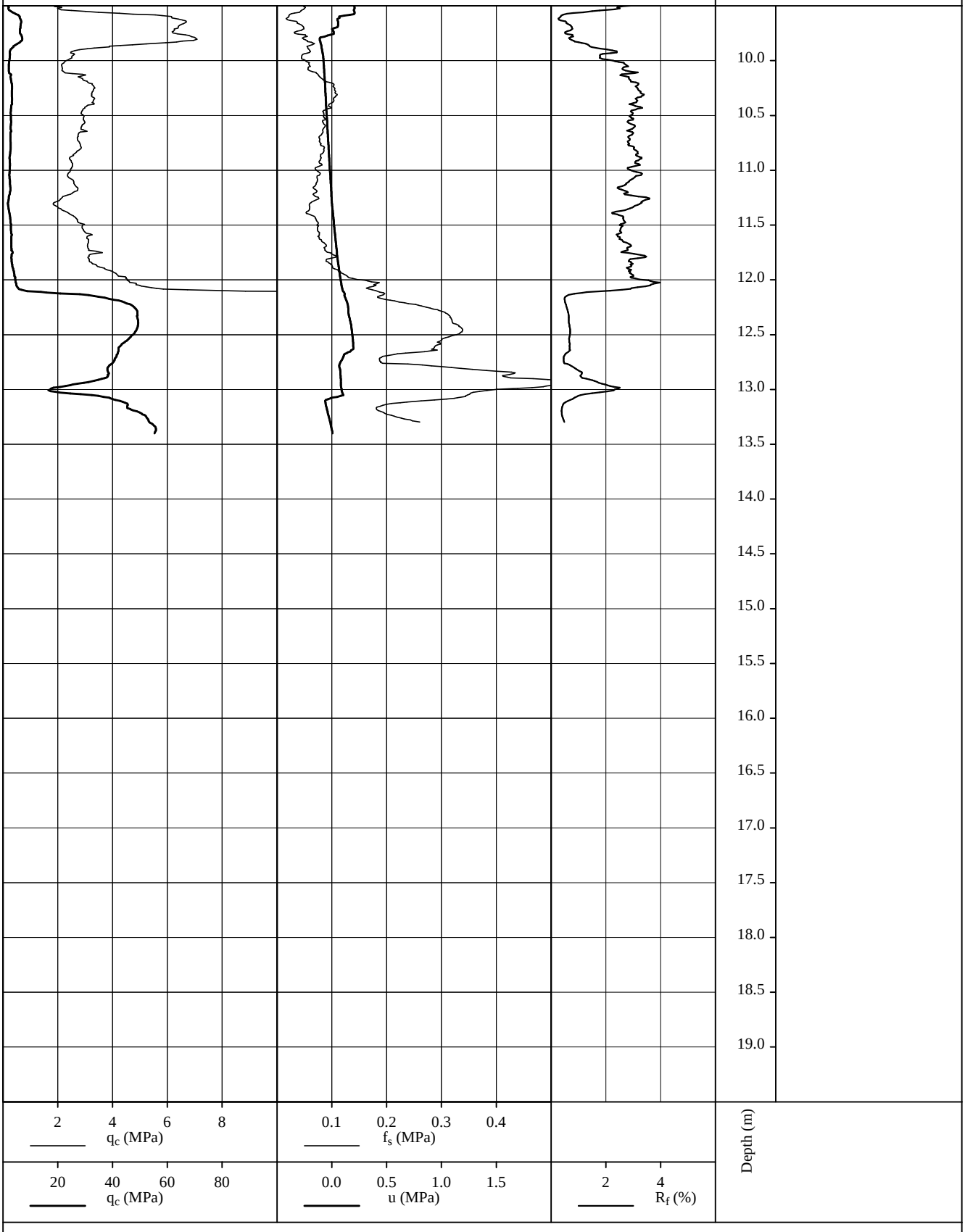
CPT name : ST14461-CPT13



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N	: 5903523,6	Cone type	: TSP	Performed by	: BVI/2014-03-13 16:25:26
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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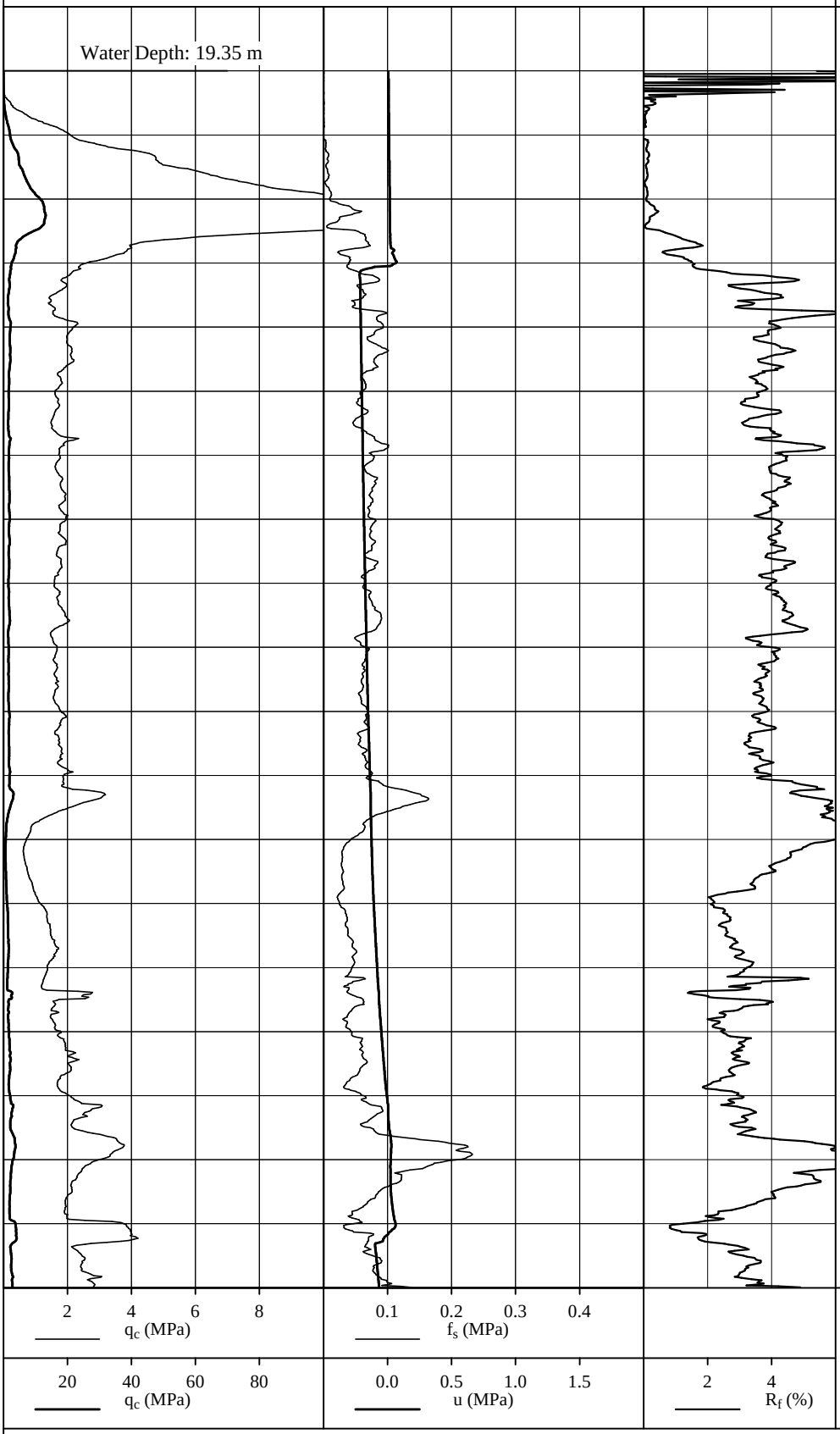
CPT name : ST14461-CPT14



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N	: 5904310.0	Cone type	: TSP	Performed by	: LEJ/2014-03-13 23:26:53
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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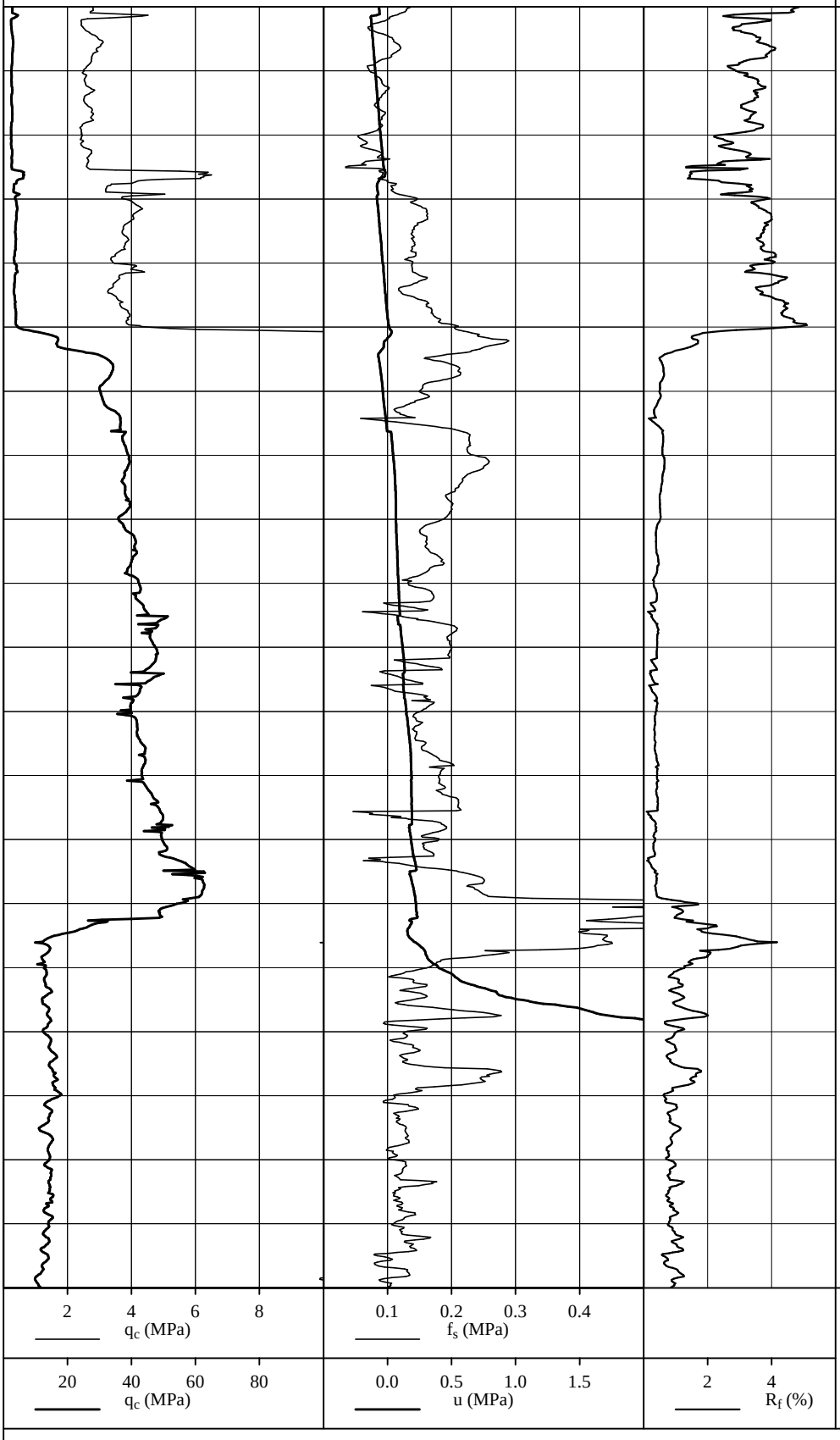
CPT name : ST14461-CPT14



E	: 388041.8	Cone no.	: 130705	Rig	: GEOScope
N	: 5904310.0	Cone type	: TSP	Performed by	: LEJ/2014-03-13 23:26:53
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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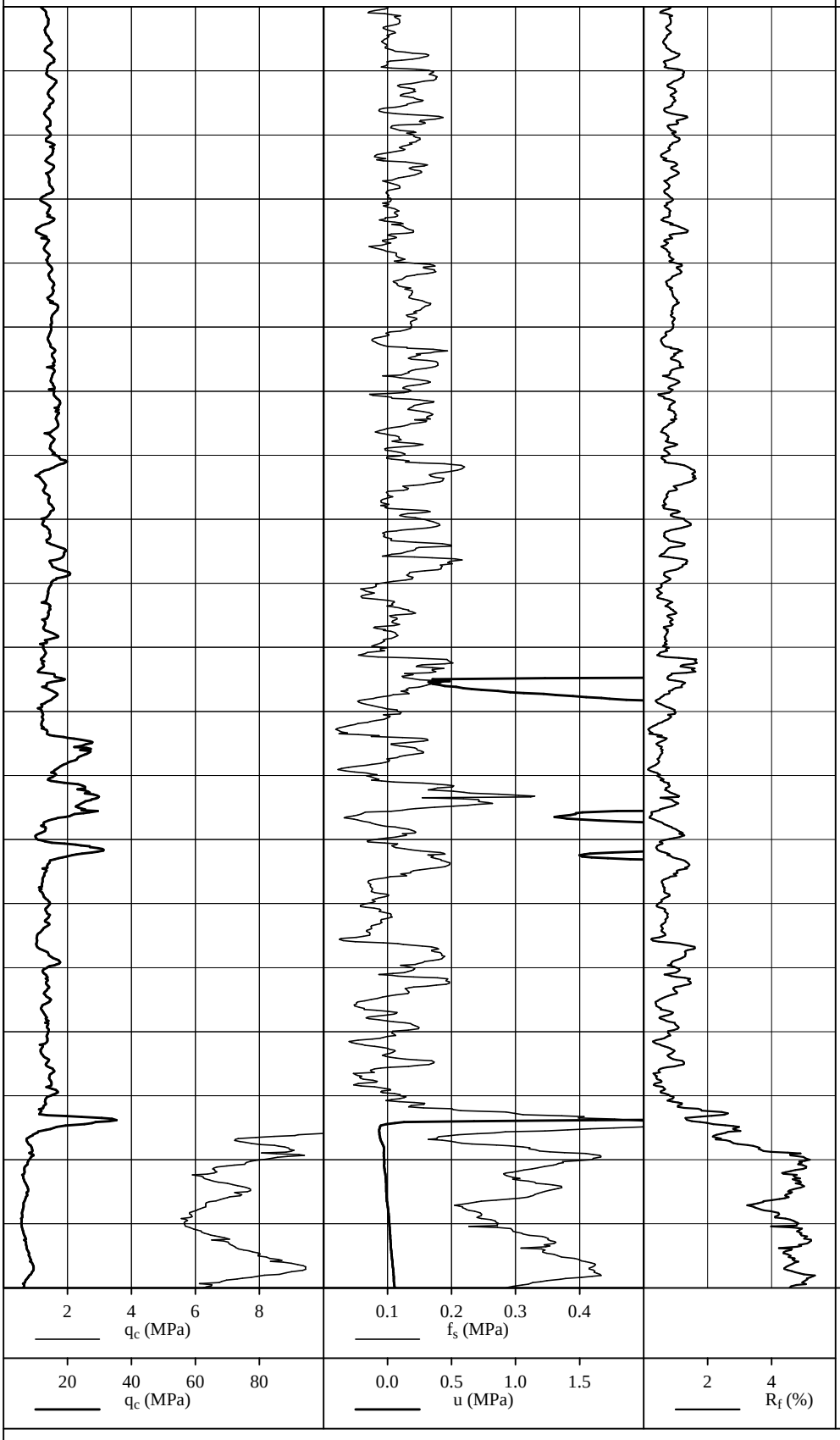
CPT name : ST14461-CPT14



E	: 388041.8	Cone no.	: 130705	Rig	: GEOScope
N	: 5904310.0	Cone type	: TSP	Performed by	: LEJ/2014-03-13 23:26:53
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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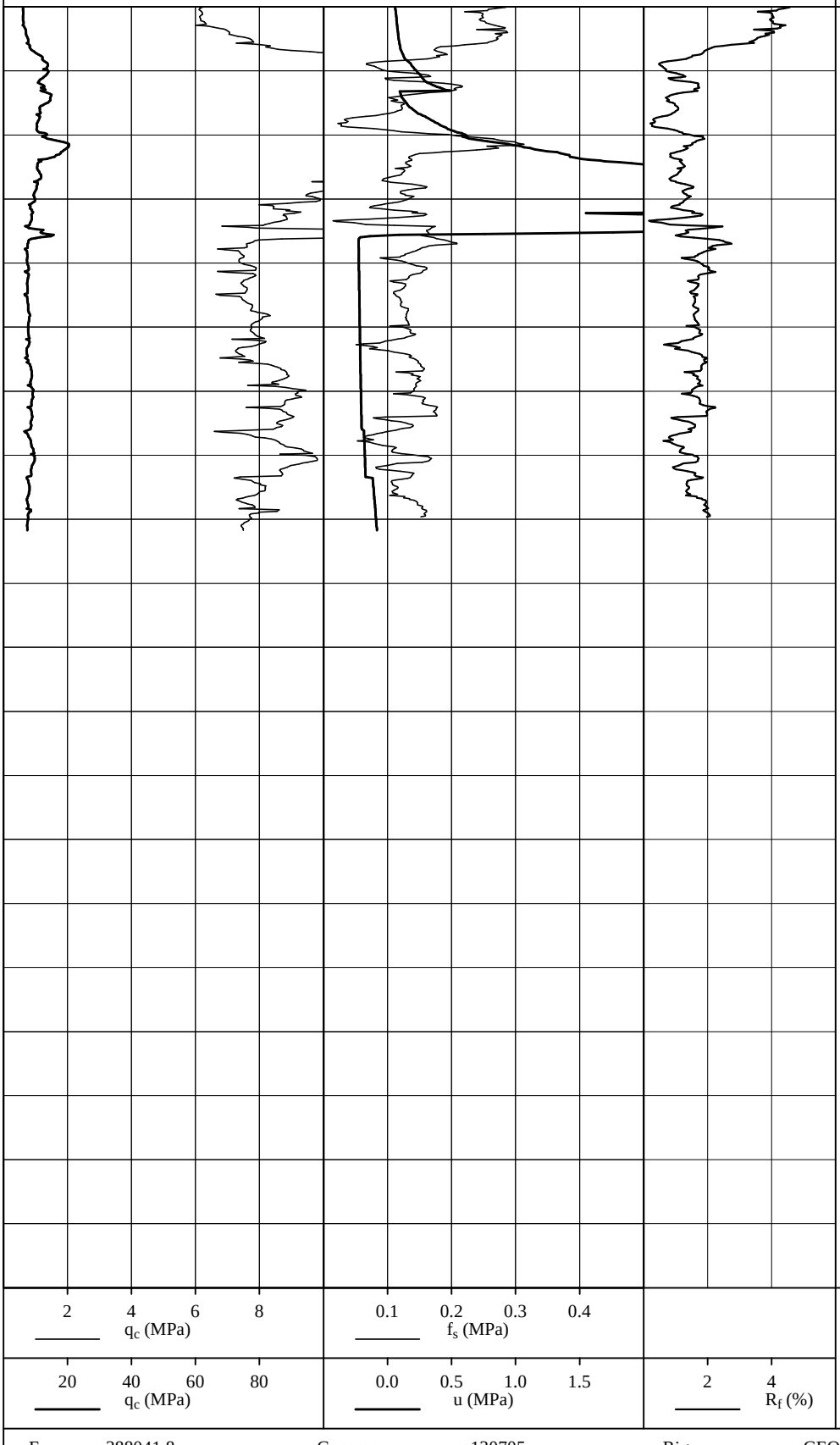
CPT name : ST14461-CPT14



E	: 388041.8	Cone no.	: 130705	Rig	: GEOScope
N	: 5904310.0	Cone type	: TSP	Performed by	: LEJ/2014-03-13 23:26:53
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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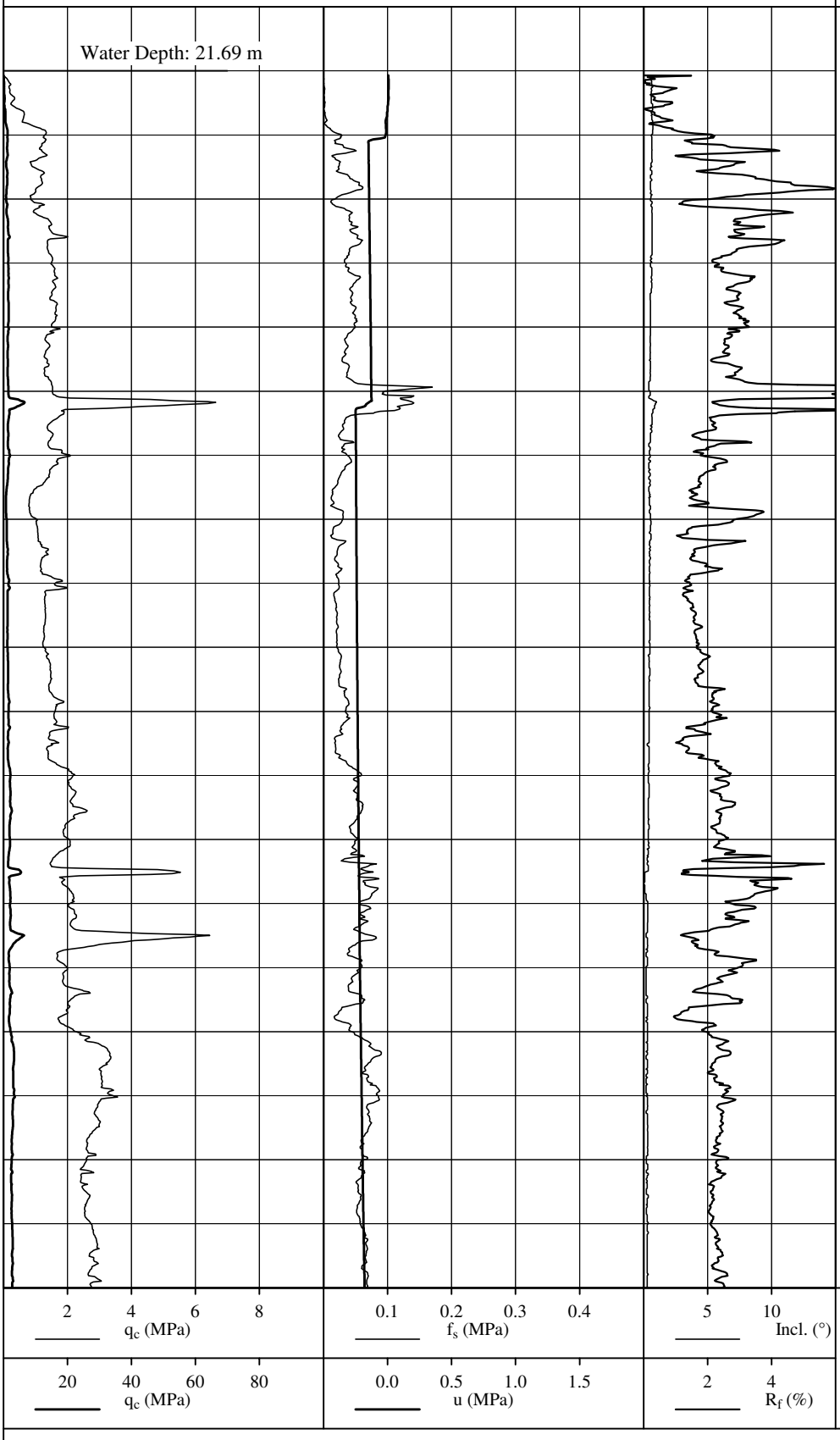
CPT name : ST14461-CPT16



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N	: 5905887,4	Cone type	: TSP	Performed by	: JPM/2014-03-14
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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Prepared	: JPM	Date : 2014-03-14	Subject: ST14461-CPT16	
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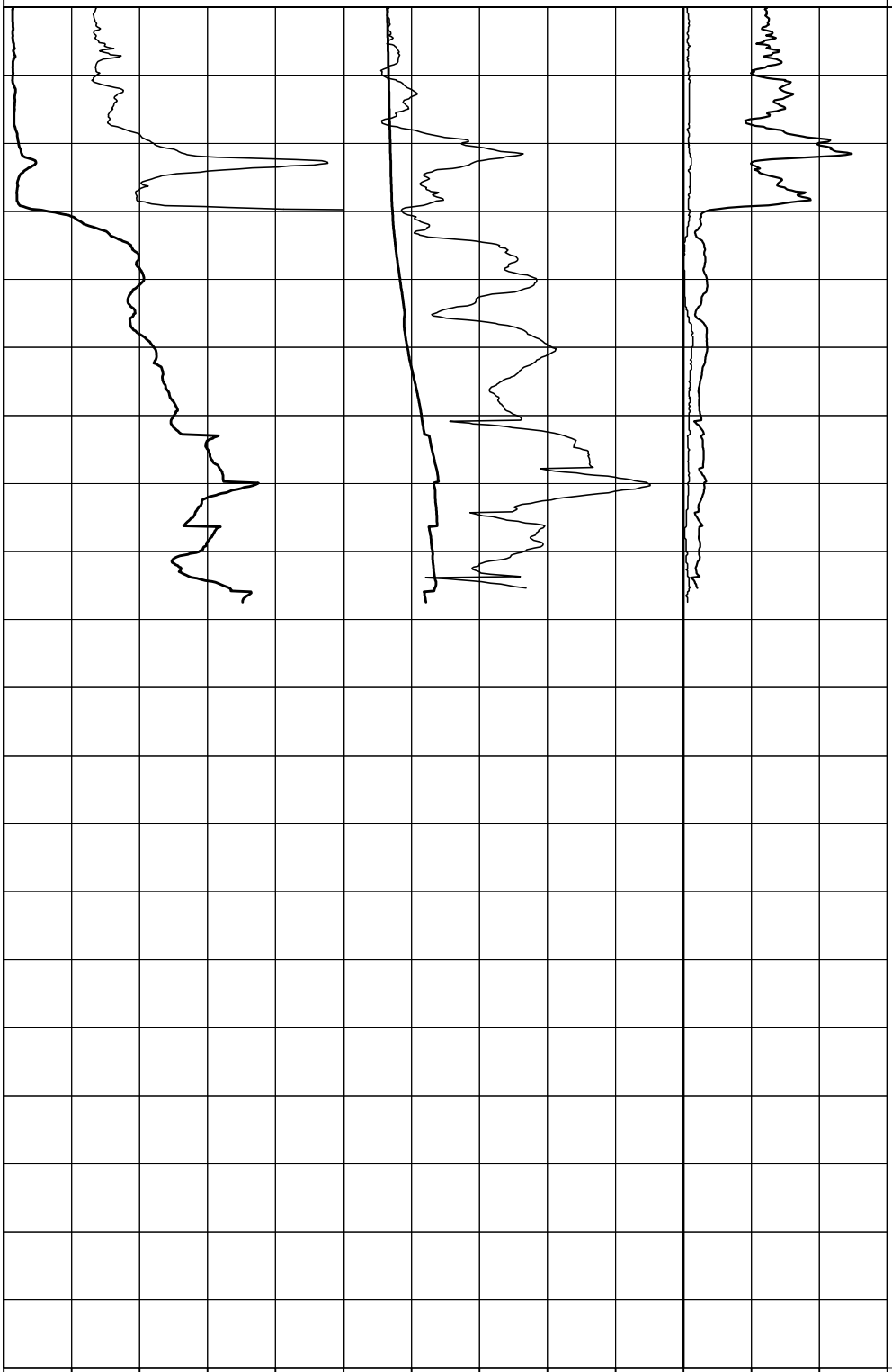
CPT name : ST14461-CPT16



2 4 6 8	0.1 0.2 0.3 0.4	5 10	Depth (m)
q_c (MPa)	f_s (MPa)	Incl. (°)	
20 40 60 80	0.0 0.5 1.0 1.5	2 4	
q_c (MPa)	u (MPa)	R_f (%)	

E	: 388152,9	Cone no.	: 130705	Rig	: GEOScope
N	: 5905887,4	Cone type	: TSP	Performed by	: JPM/2014-03-14
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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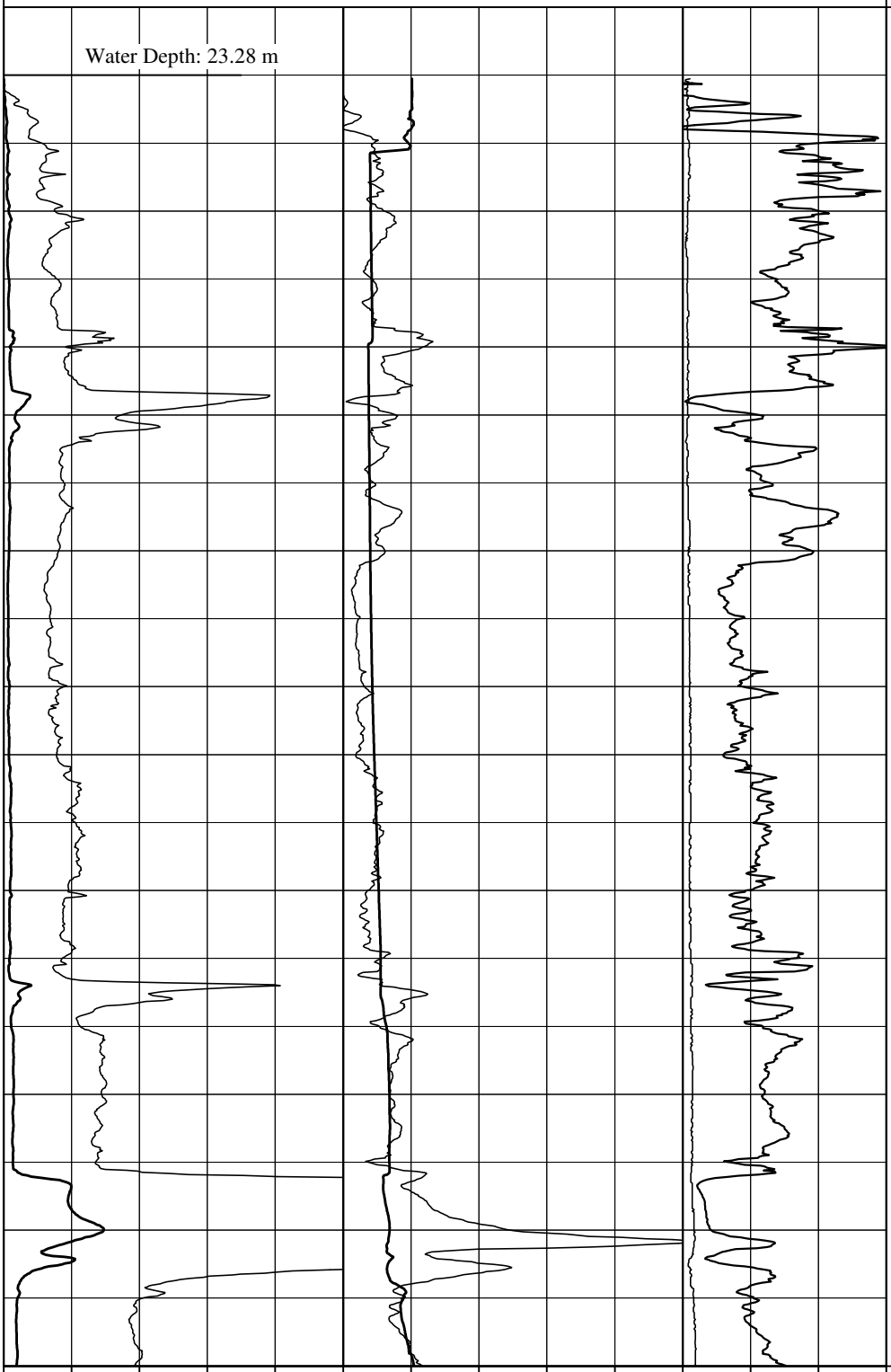
CPT name : ST14461-CPT17



E	: 388209,1	Cone no.	: 130705	Rig	: GEOScope
N	: 5906674,8	Cone type	: TSP	Performed by	: JPM/2014-03-14
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Tip

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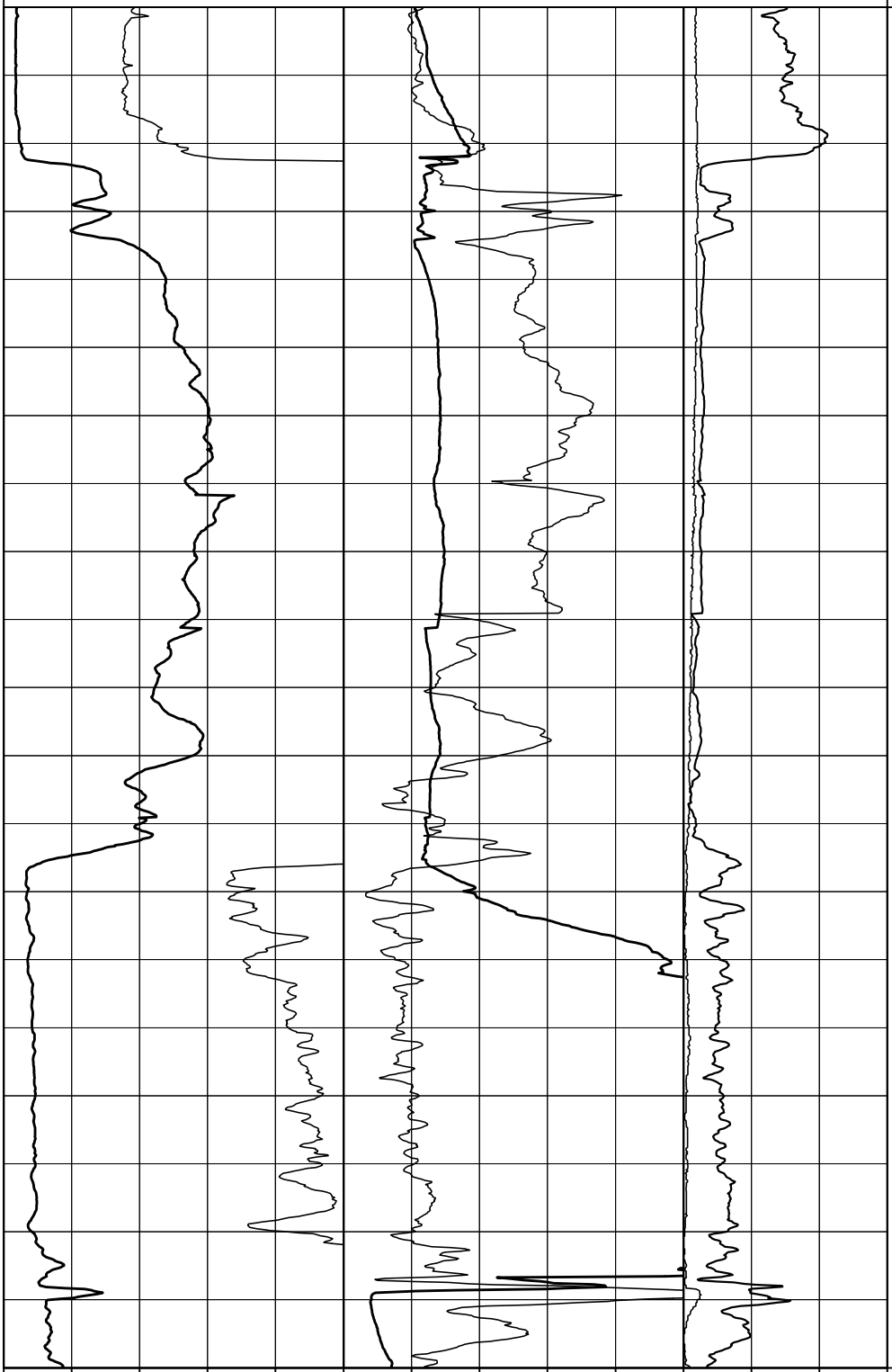
CPT name : ST14461-CPT17



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System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Tip

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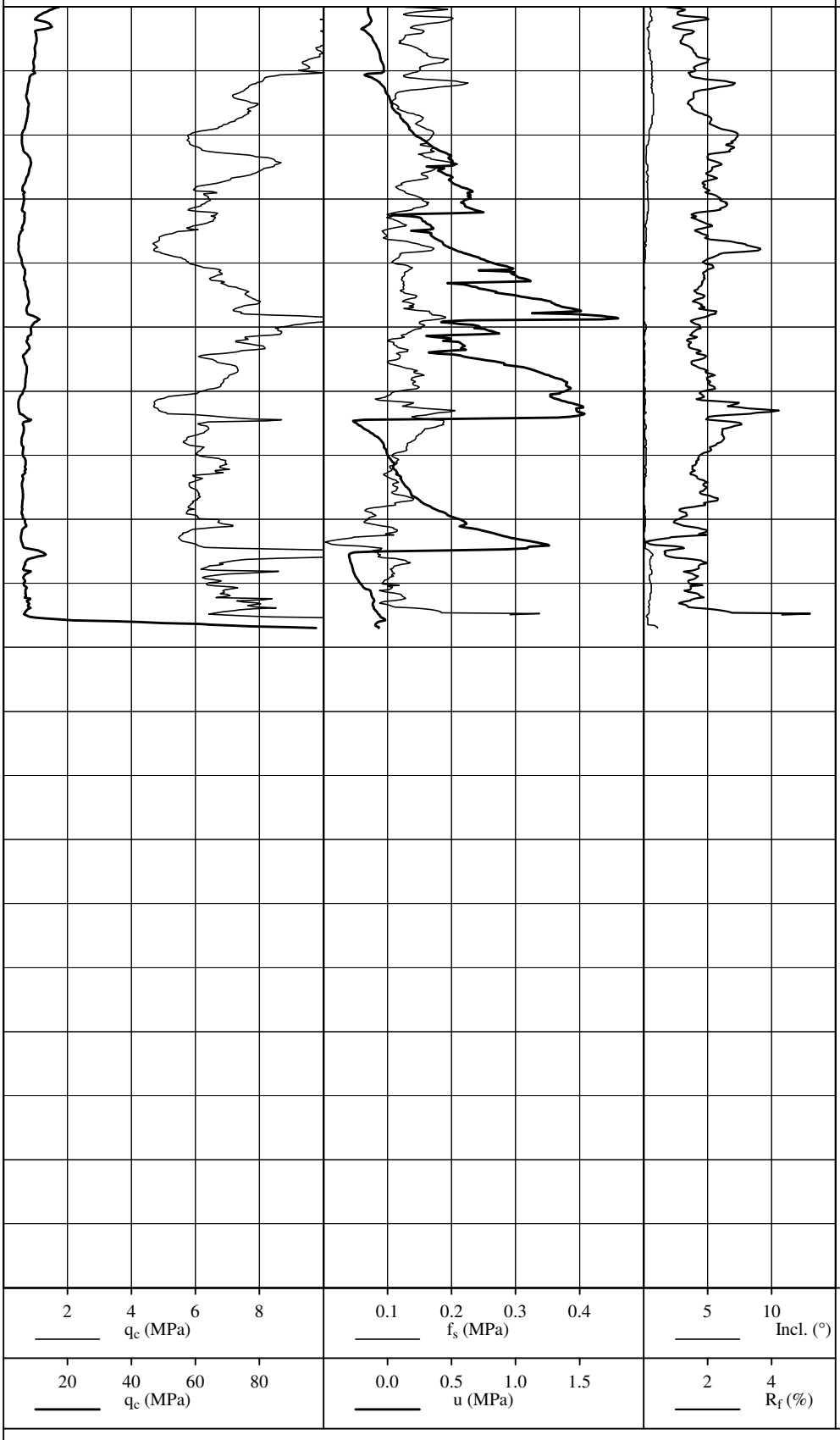
CPT name : ST14461-CPT17



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System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Tip

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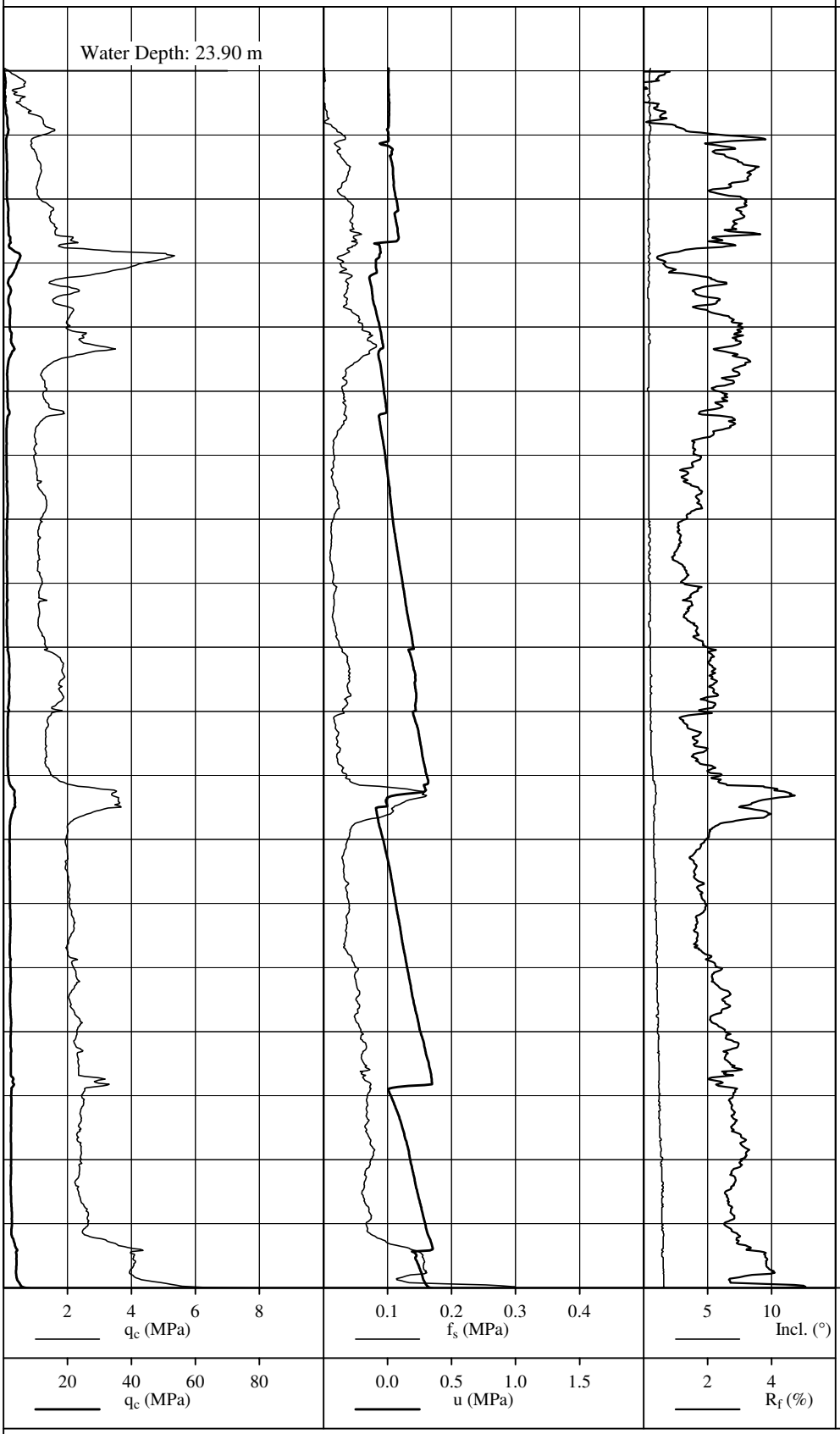
CPT name : ST14461-CPT18



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N	: 5907462,8	Cone type	: TSP	Performed by	: JPM/2014-03-14
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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Prepared	: JPM	Date : 2014-03-14	Subject: ST14461-CPT18	
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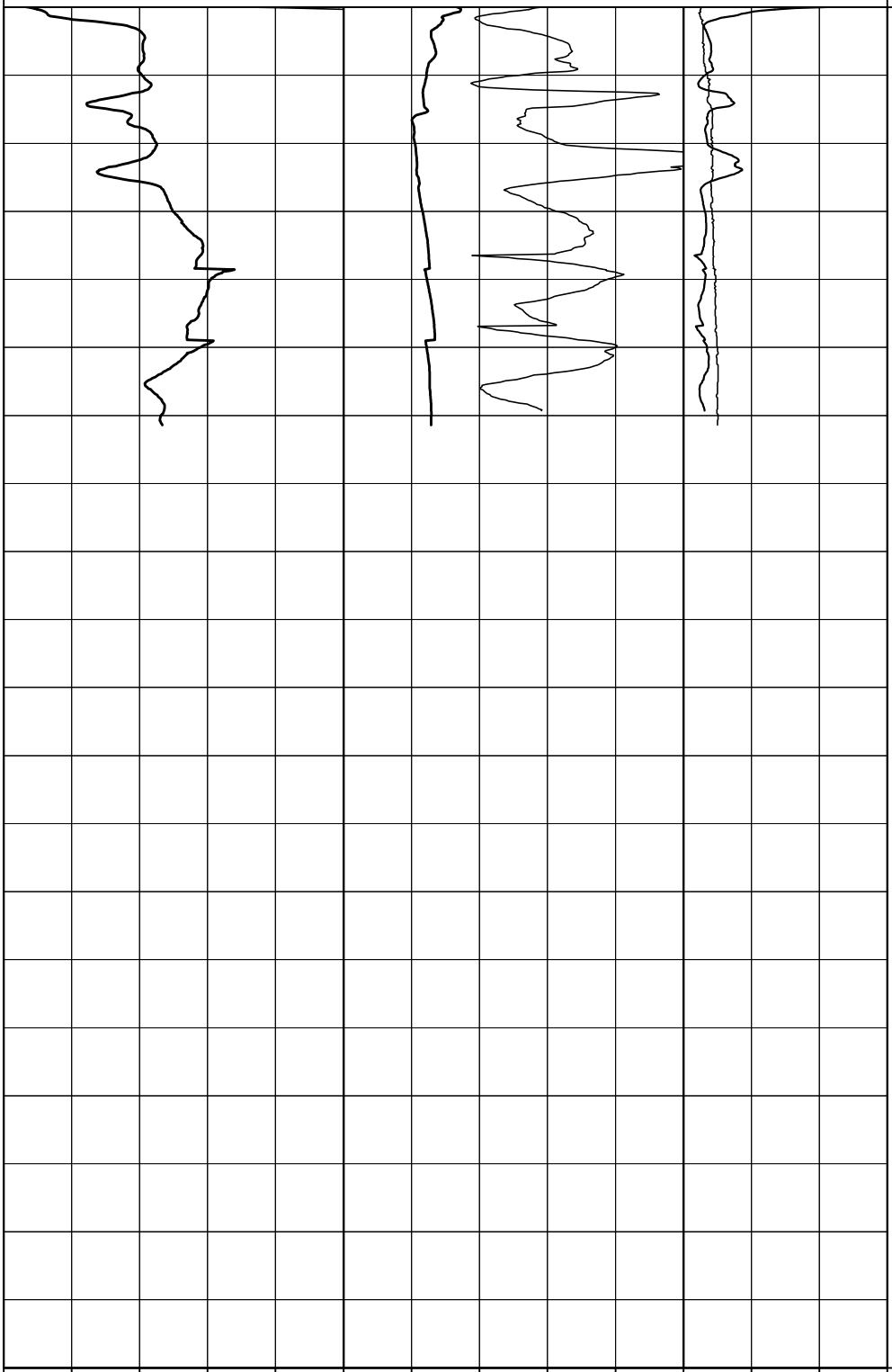
CPT name : ST14461-CPT18



2 4 6 8
q_c (MPa)

0.1 0.2 0.3 0.4
f_s (MPa)

5 10
Incl. (°)

Depth (m)

20 40 60 80
q_c (MPa)

0.0 0.5 1.0 1.5
u (MPa)

2 4
R_f (%)

E	: 388246,3	Cone no.	: 130705	Rig	: GEOScope
N	: 5907462,8	Cone type	: TSP	Performed by	: JPM/2014-03-14
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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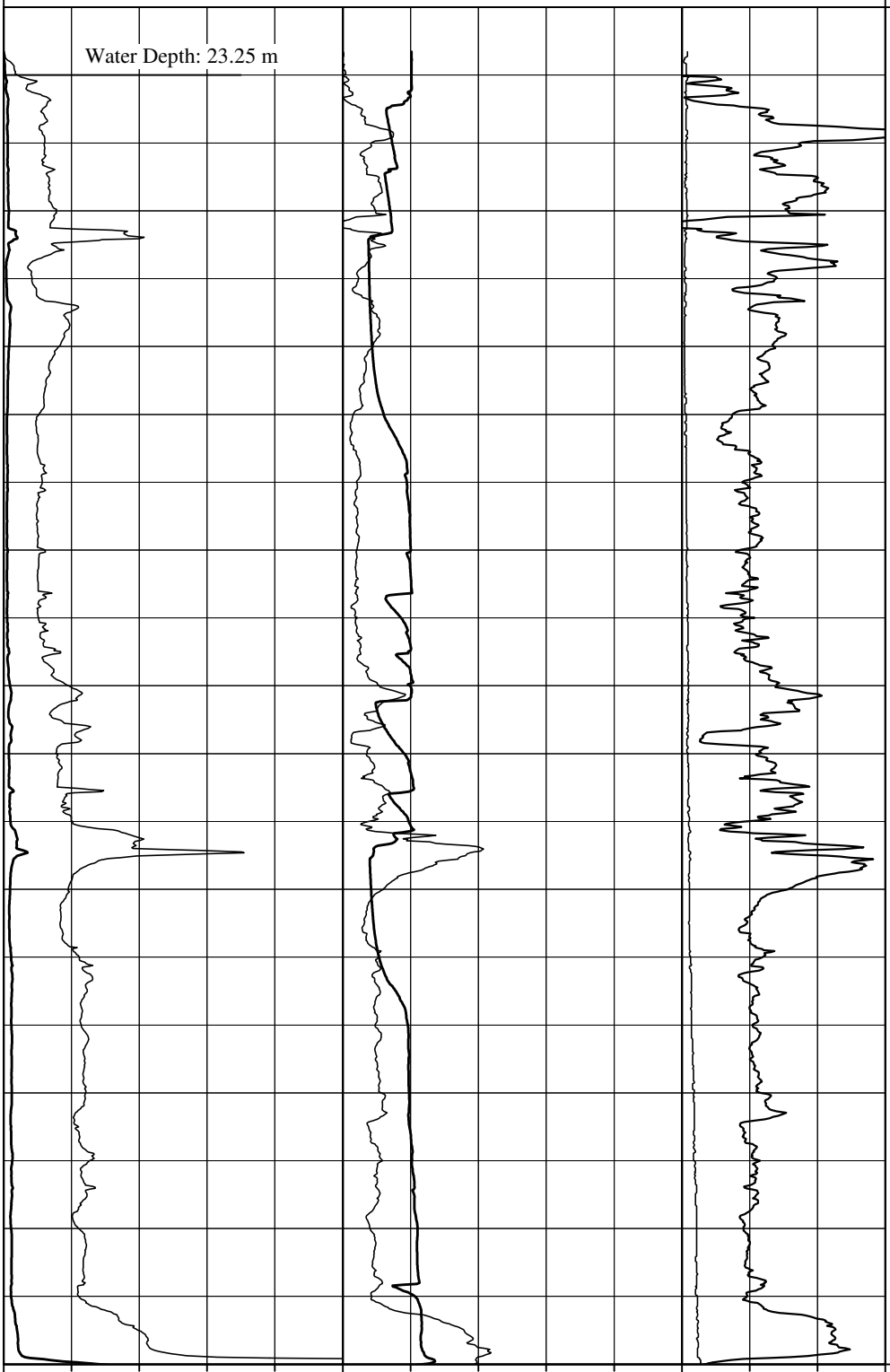
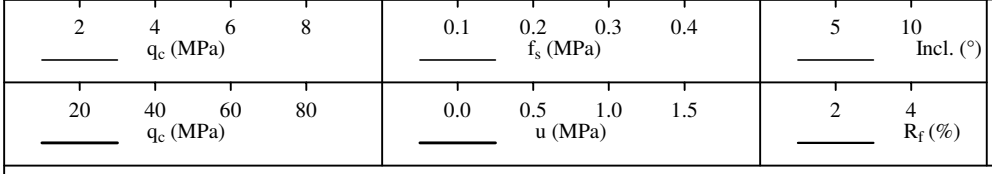
CPT name : ST14461-CPT18a





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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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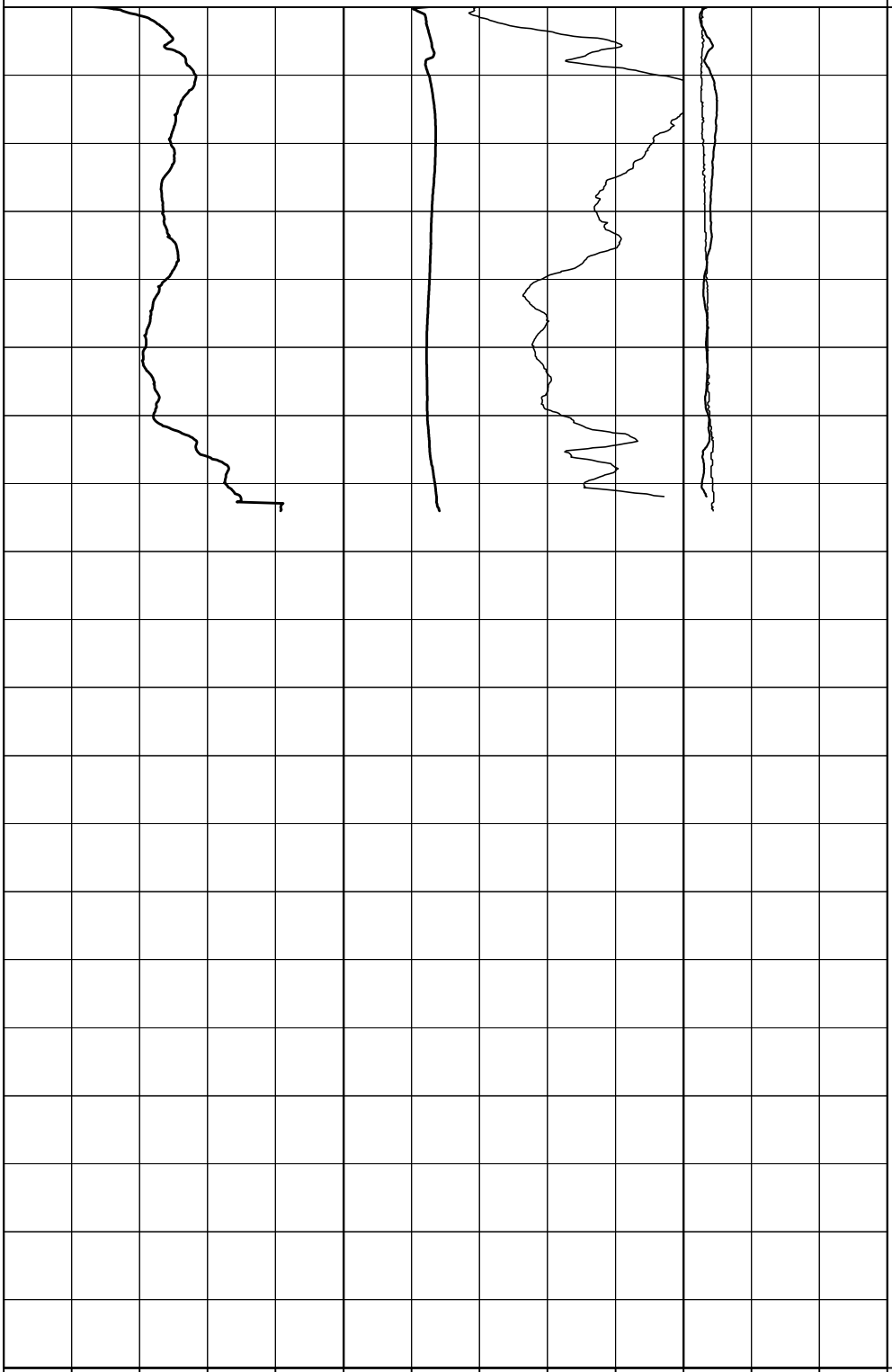
CPT name : ST14461-CPT18a



2 4 6 8 q_c (MPa)	0.1 0.2 0.3 0.4 f_s (MPa)	5 10 Incl. (°)	Depth (m)
20 40 60 80 q_c (MPa)	0.0 0.5 1.0 1.5 u (MPa)	2 4 R_f (%)	

E	: 388262,2	Cone no.	: 130705	Rig	: GEOScope
N	: 5907467,4	Cone type	: TSP	Performed by	: JPM/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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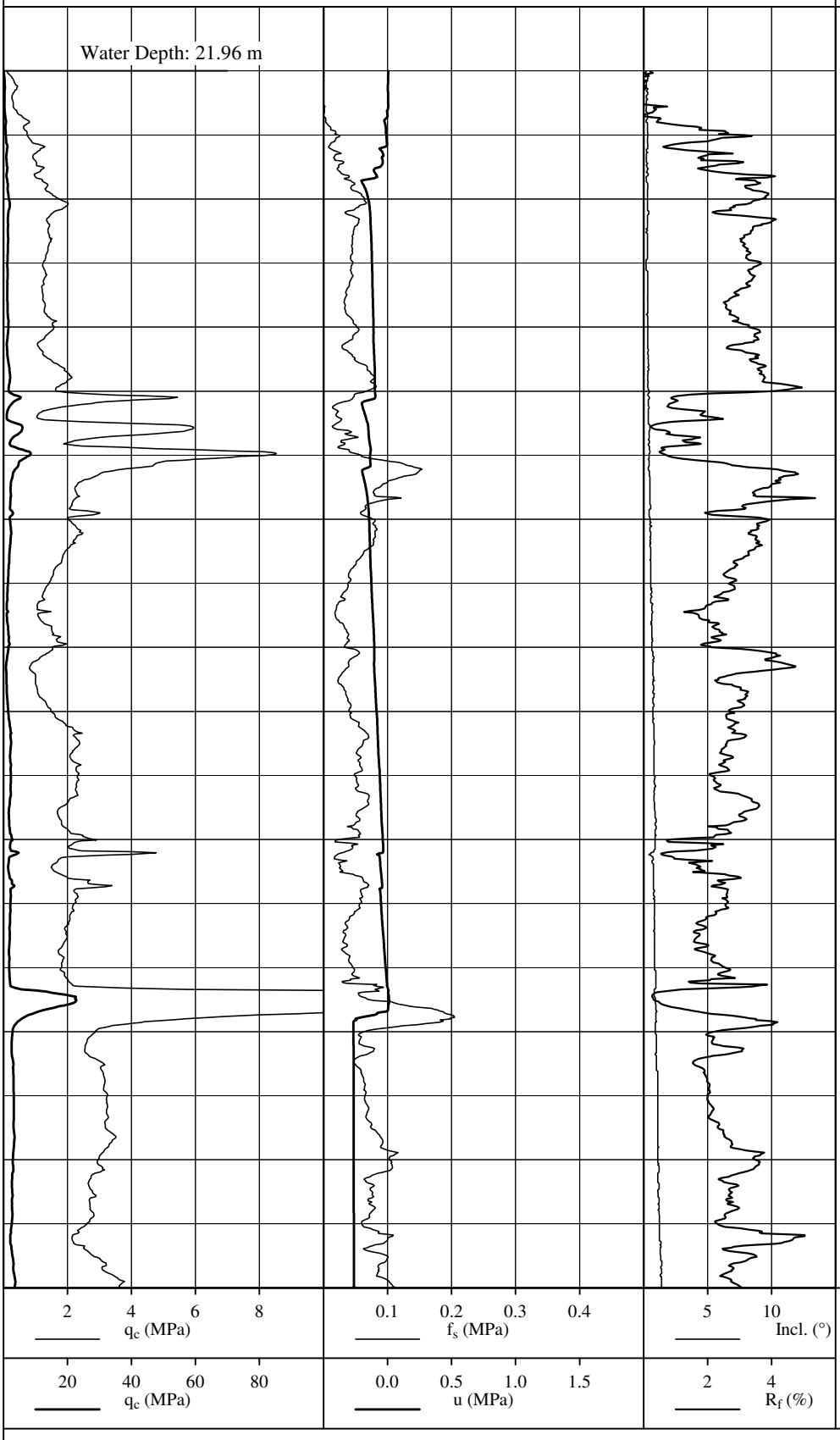
CPT name : ST14461-CPT19



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N	: 5907929,9	Cone type	: TSP	Performed by	: BVI/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max thrust

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Prepared	: BVI	Date: 2014-03-14	Subject: ST14461-CPT19		
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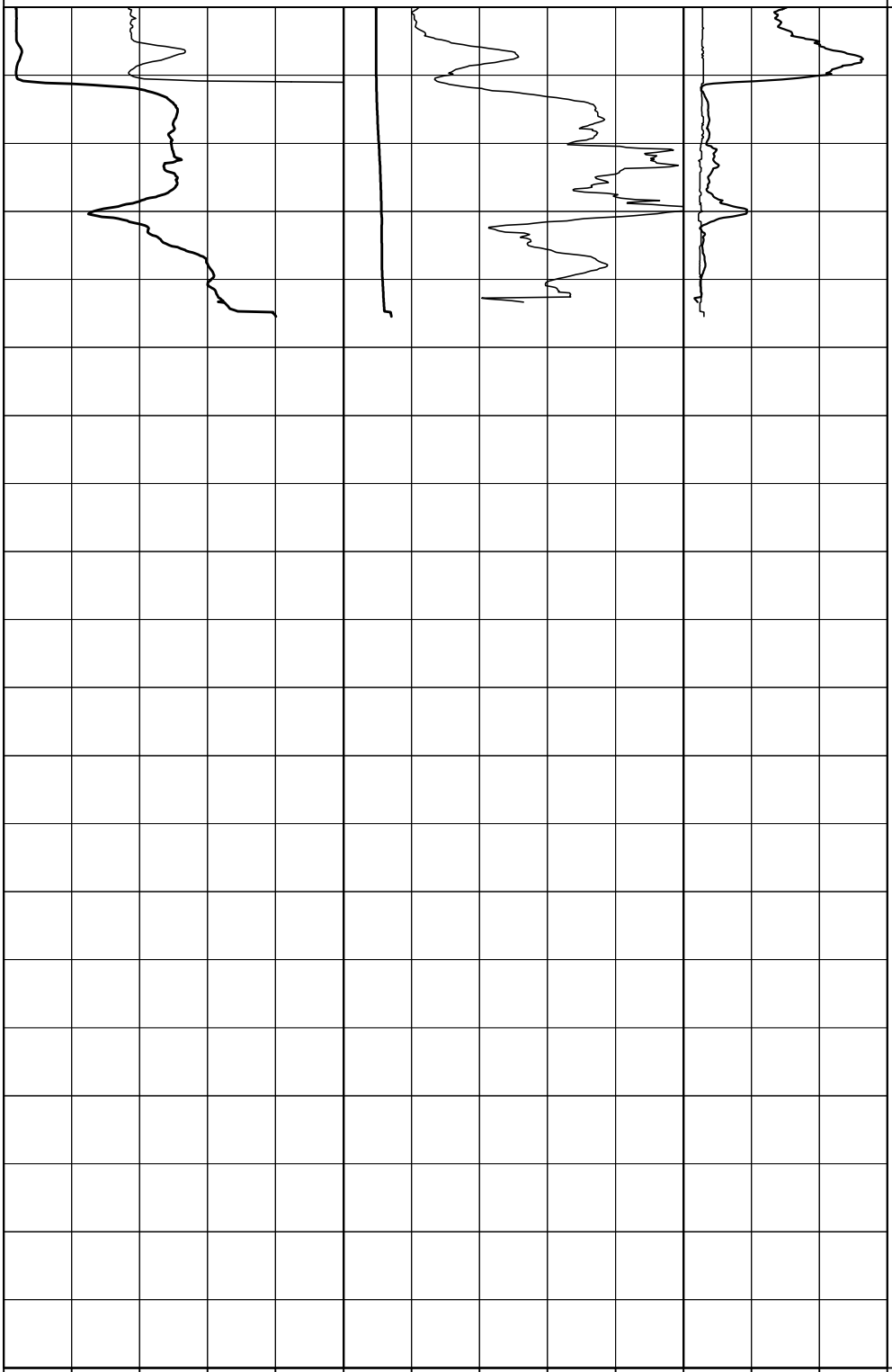
CPT name : ST14461-CPT19



2 4 6 8 q_c (MPa)	0.1 0.2 0.3 0.4 f_s (MPa)	5 10 Incl. (°)	Depth (m)
20 40 60 80 q_c (MPa)	0.0 0.5 1.0 1.5 u (MPa)	2 4 R_f (%)	

E	: 388971,5	Cone no.	: 130705	Rig	: GEOScope
N	: 5907929,9	Cone type	: TSP	Performed by	: BVI/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max thrust

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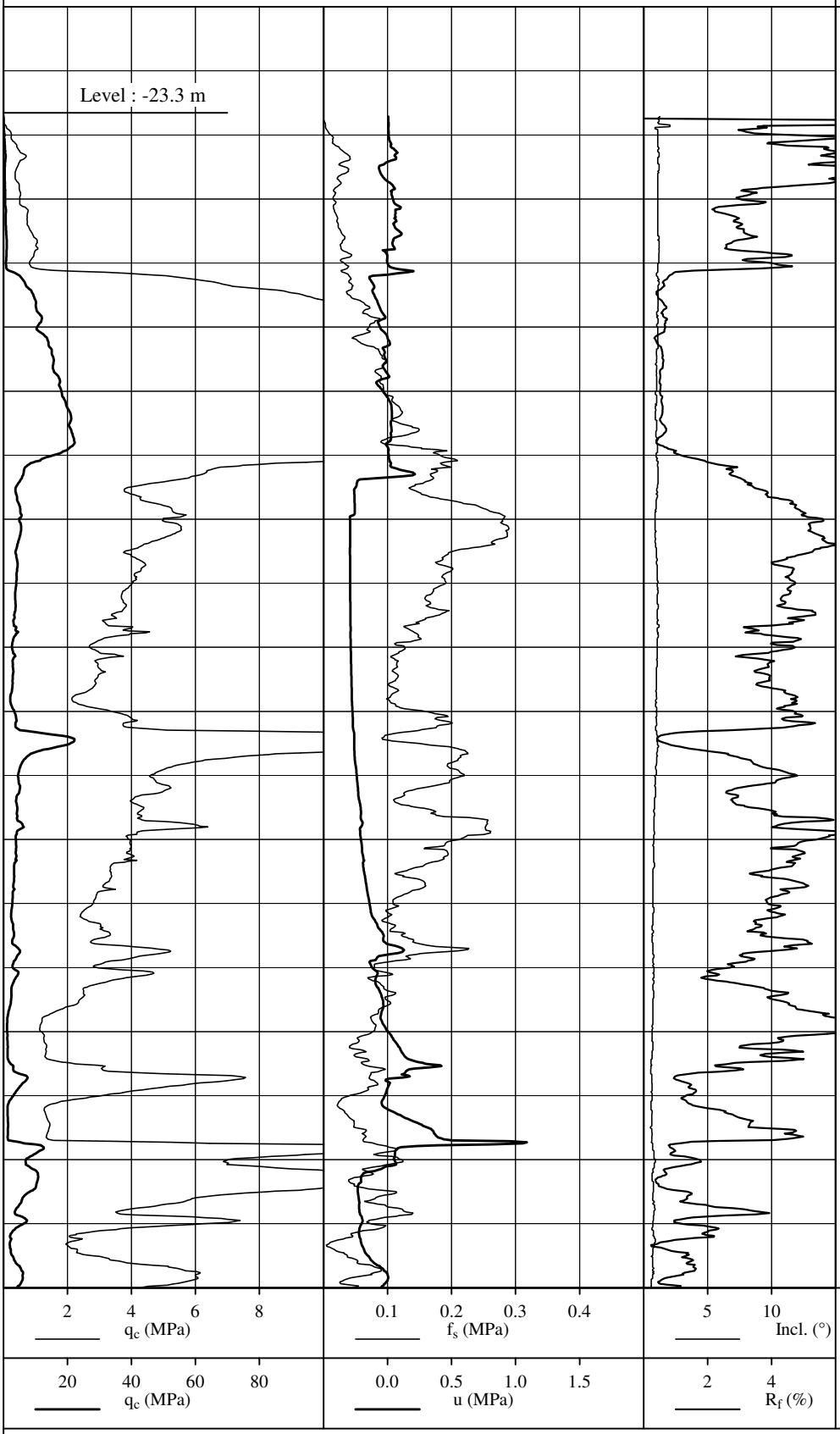
CPT name : ST14461-CPT2



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N	: 5897572.9	Cone type	: TSP	Performed by	: JPM/2014-03-12
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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Prepared	: ABP	Date: 2014-03-12	Subject: ST14461-CPT2	
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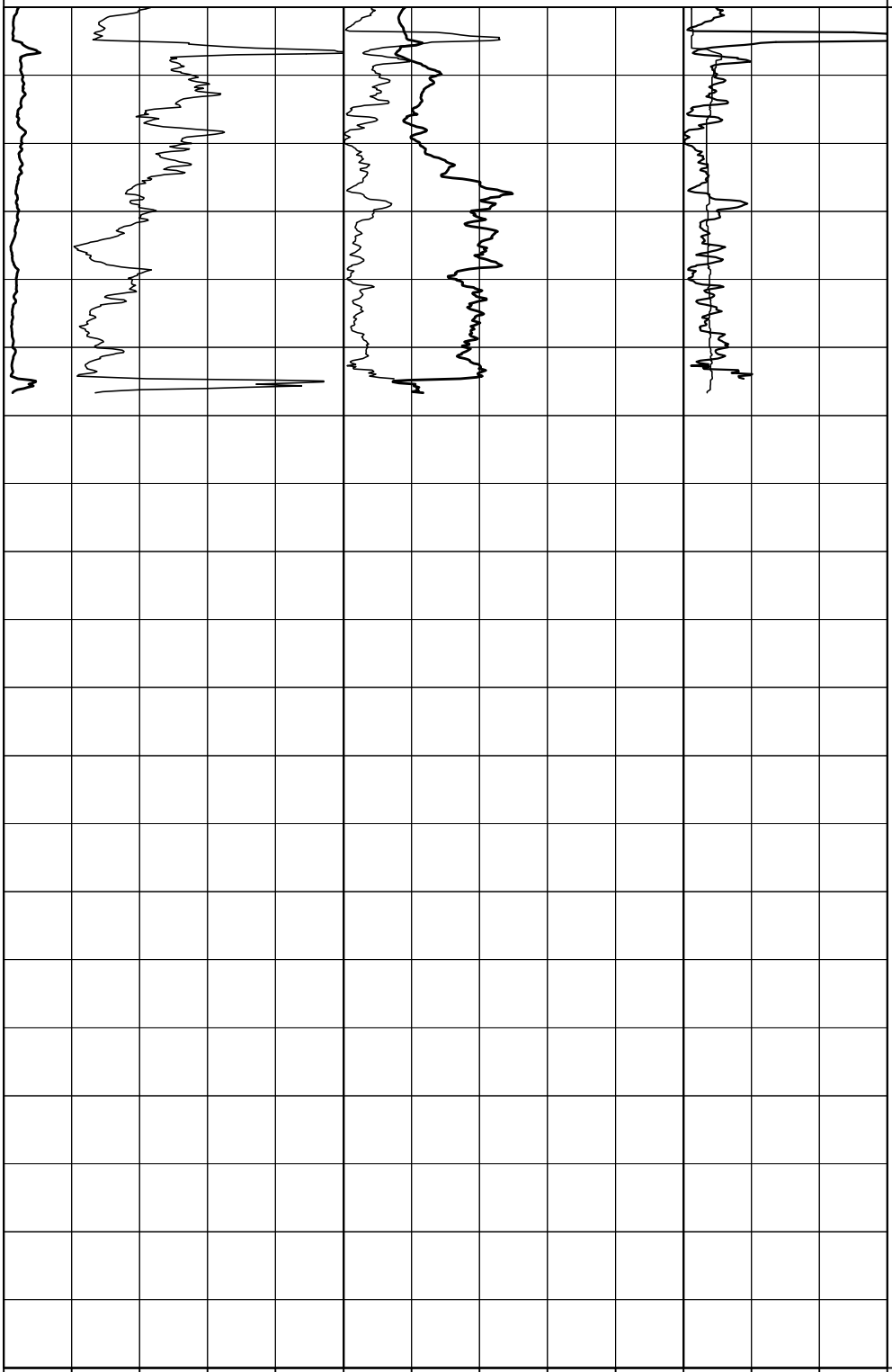
CPT name : ST14461-CPT2



E	: 394325.0	Cone no.	: 130811	Rig	: GEOScope
N	: 5897572.9	Cone type	: TSP	Performed by	: JPM/2014-03-12
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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Prepared	: ABP	Date: 2014-03-12	Subject: ST14461-CPT2	
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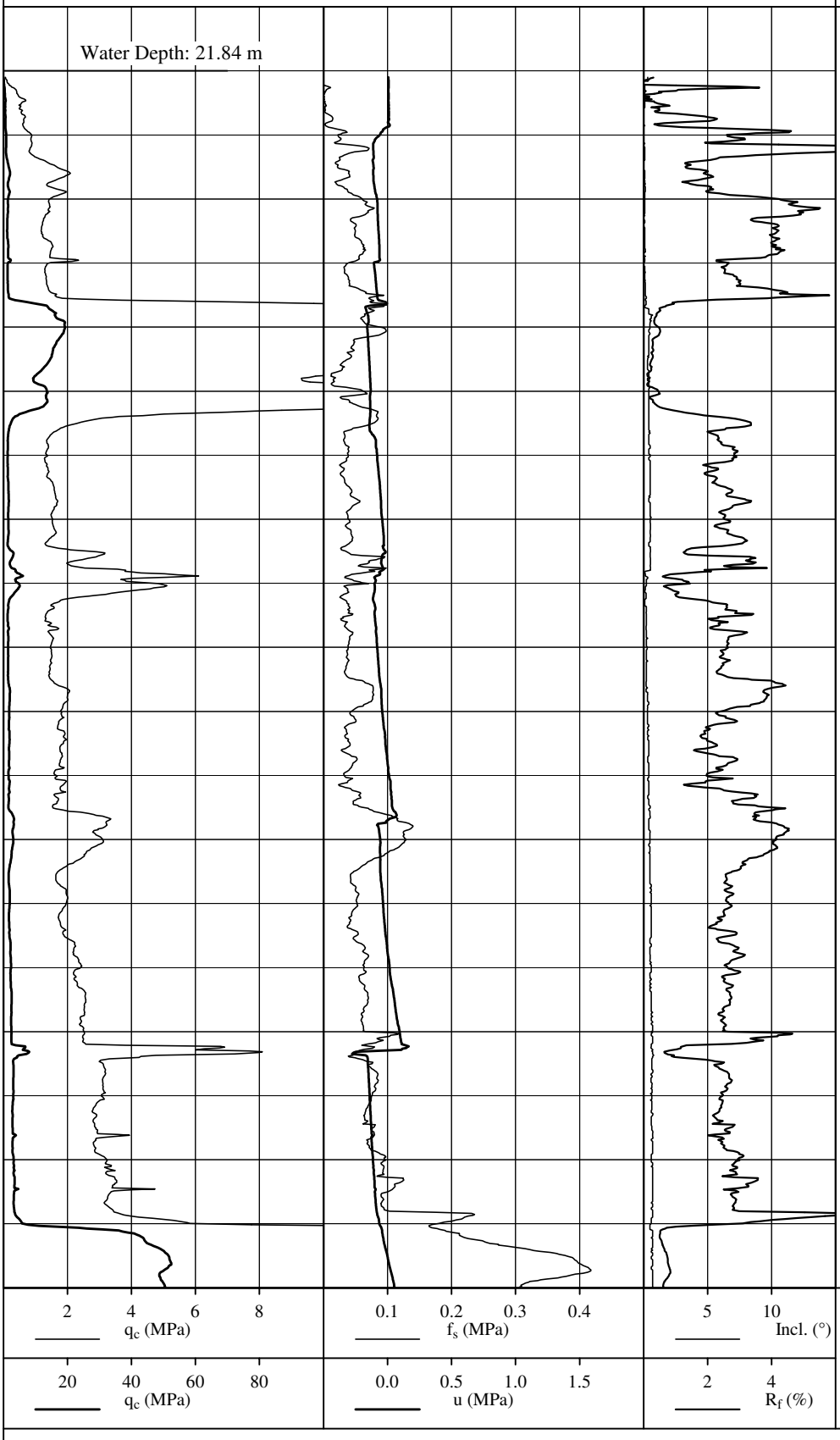
CPT name : ST14461-CPT20



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N	: 58908466,1	Cone type	: TSP	Performed by	: BVI/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max thrust

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Prepared	: BVI	Date: 2014-03-14	Subject: ST14461-CPT20	
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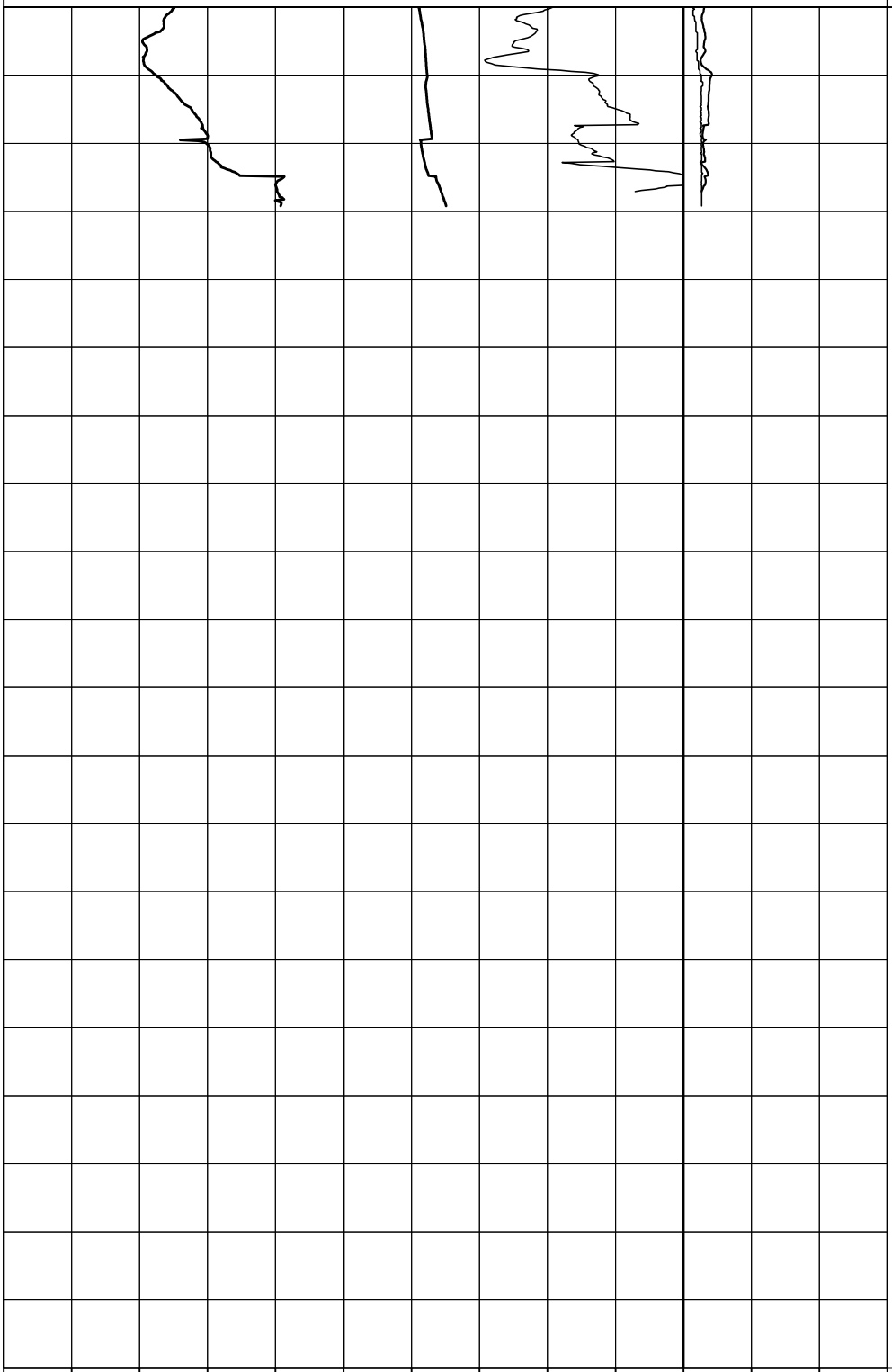
CPT name : ST14461-CPT20



2 4 6 8 q_c (MPa)	0.1 0.2 0.3 0.4 f_s (MPa)	5 10 Incl. (°)	Depth (m)
20 40 60 80 q_c (MPa)	0.0 0.5 1.0 1.5 u (MPa)	2 4 R_f (%)	

E	: 389623,0	Cone no.	: 130705	Rig	: GEOScope
N	: 58908466,1	Cone type	: TSP	Performed by	: BVI/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max thrust

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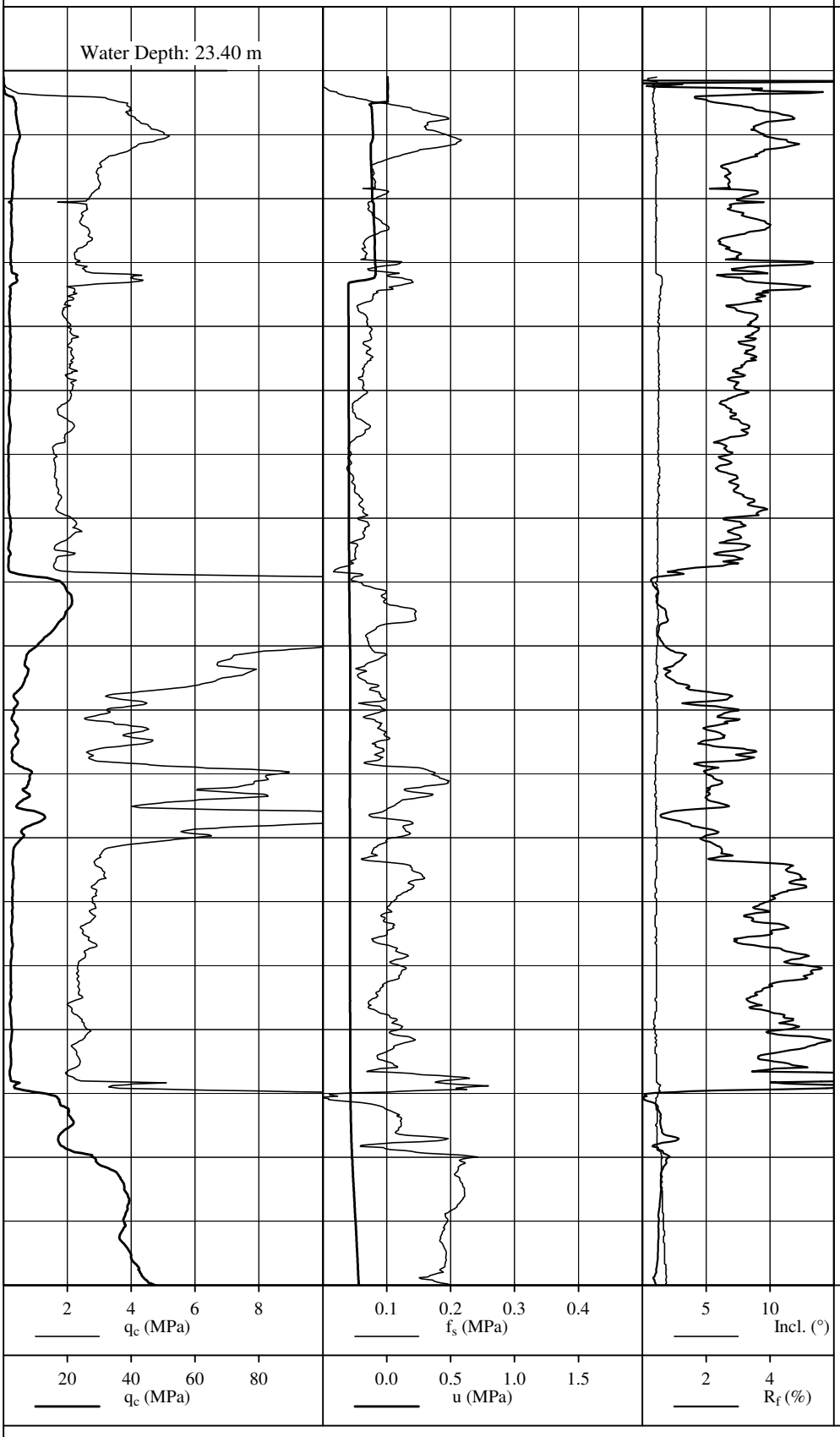
CPT name : ST14461-CPT22



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N	: 5907485,8	Cone type	: TSP	Performed by	: BVI/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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Prepared	: LEJ	Date: 2014-03-14	Subject: ST14461-CPT22	
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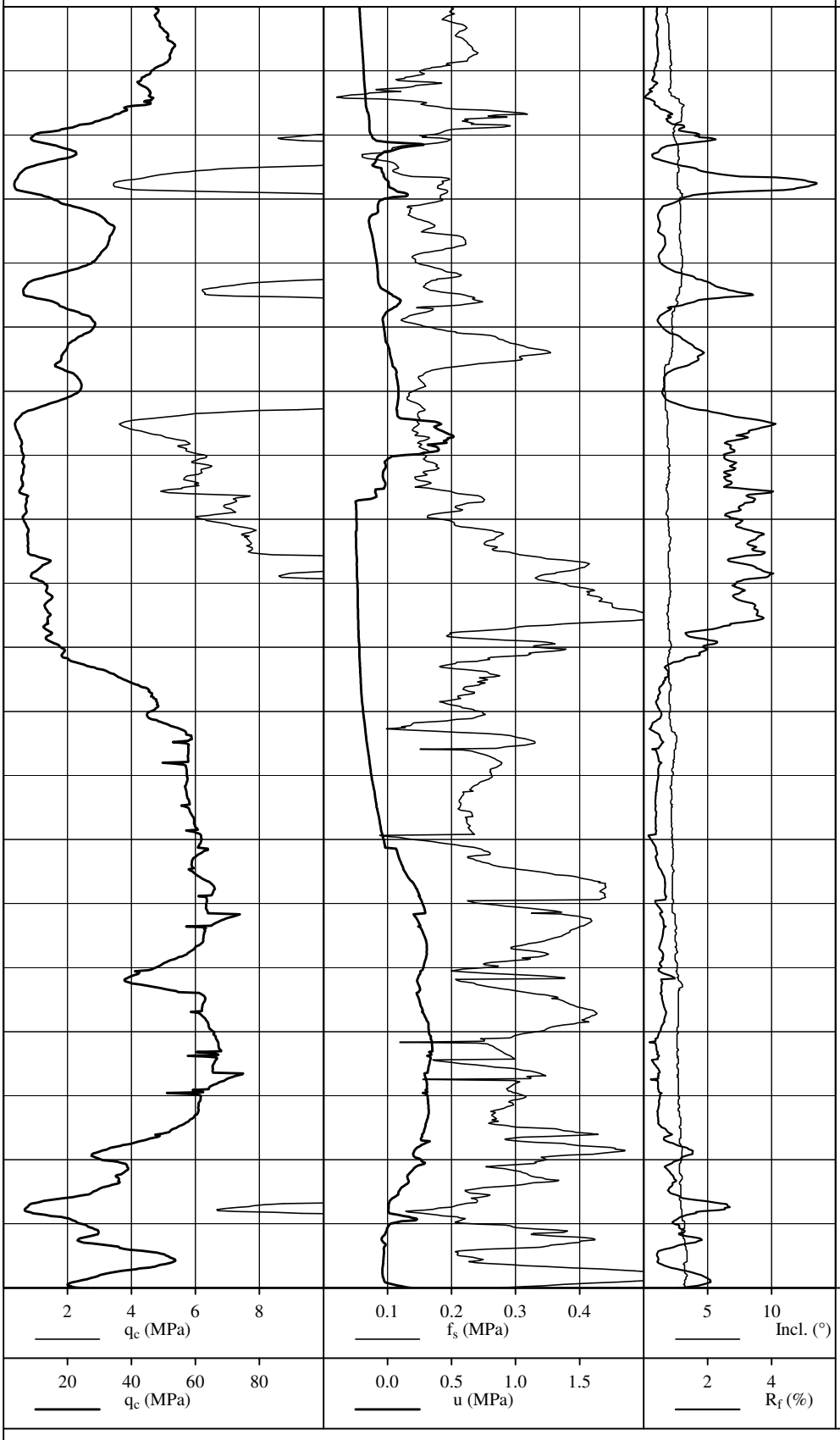
CPT name : ST14461-CPT22



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N	: 5907485,8	Cone type	: TSP	Performed by	: BVI/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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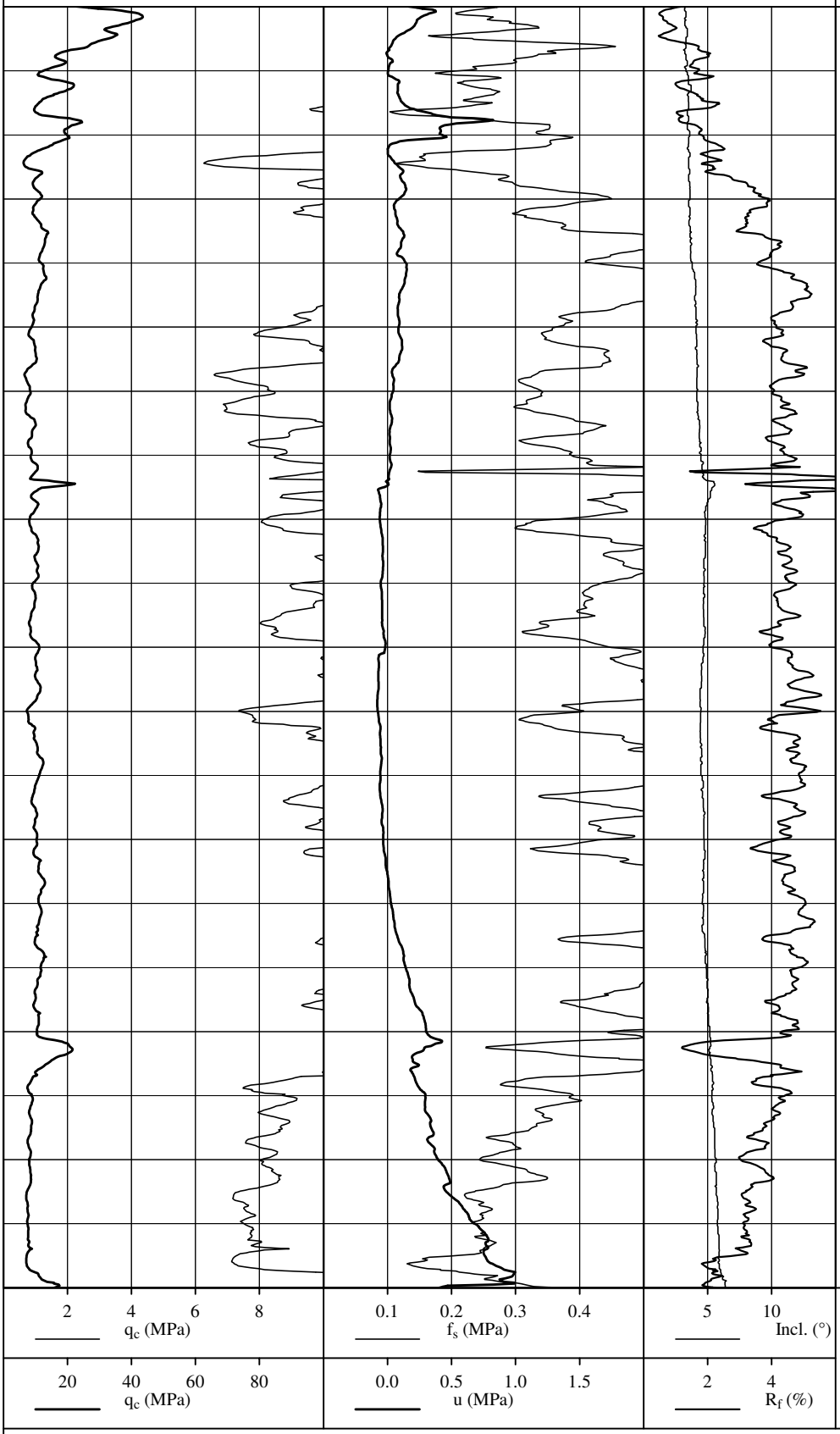
CPT name : ST14461-CPT22



E	: 390834,4	Cone no.	: 130705	Rig	: GEOScope
N	: 5907485,8	Cone type	: TSP	Performed by	: BVI/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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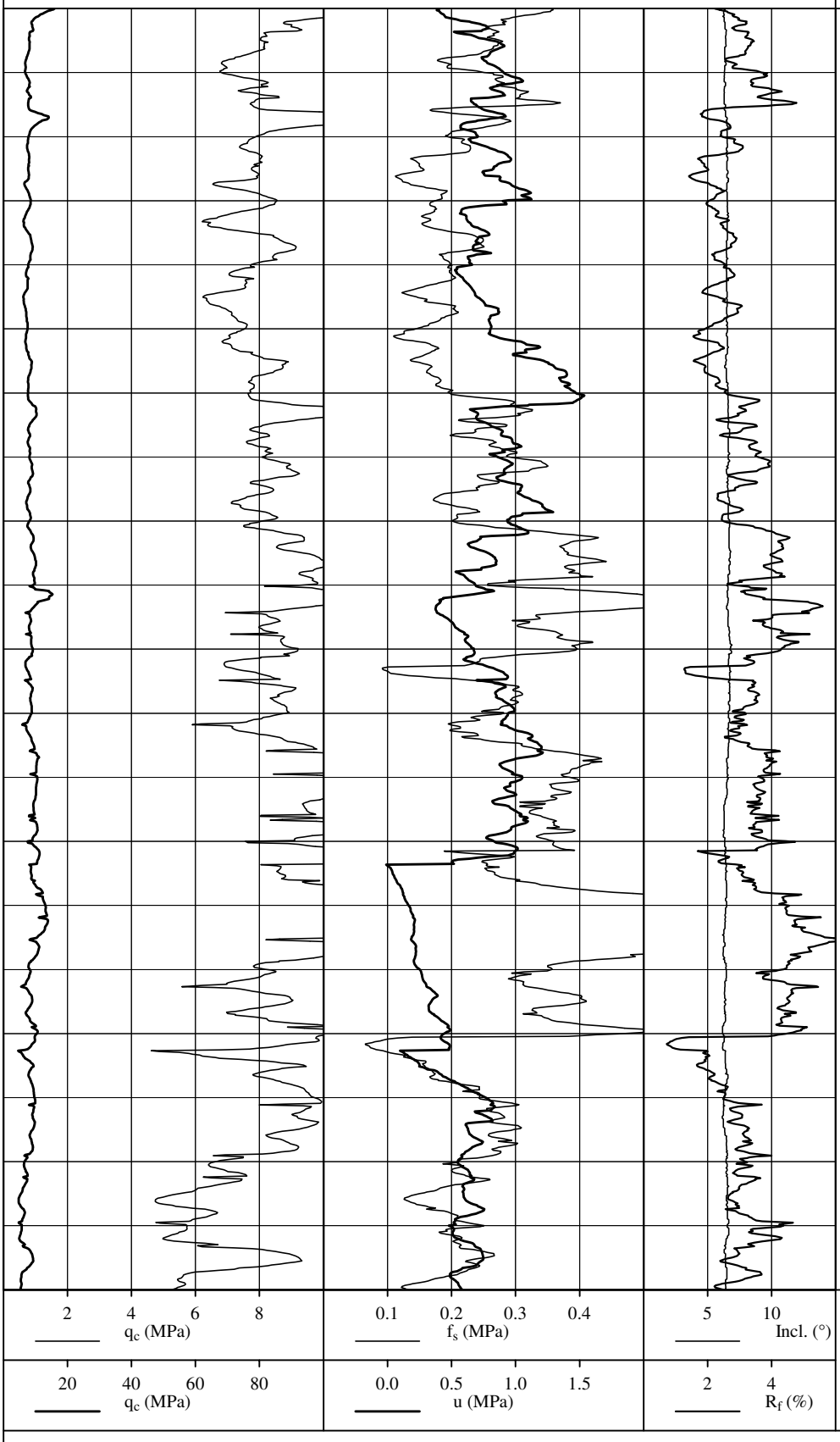
CPT name : ST14461-CPT22



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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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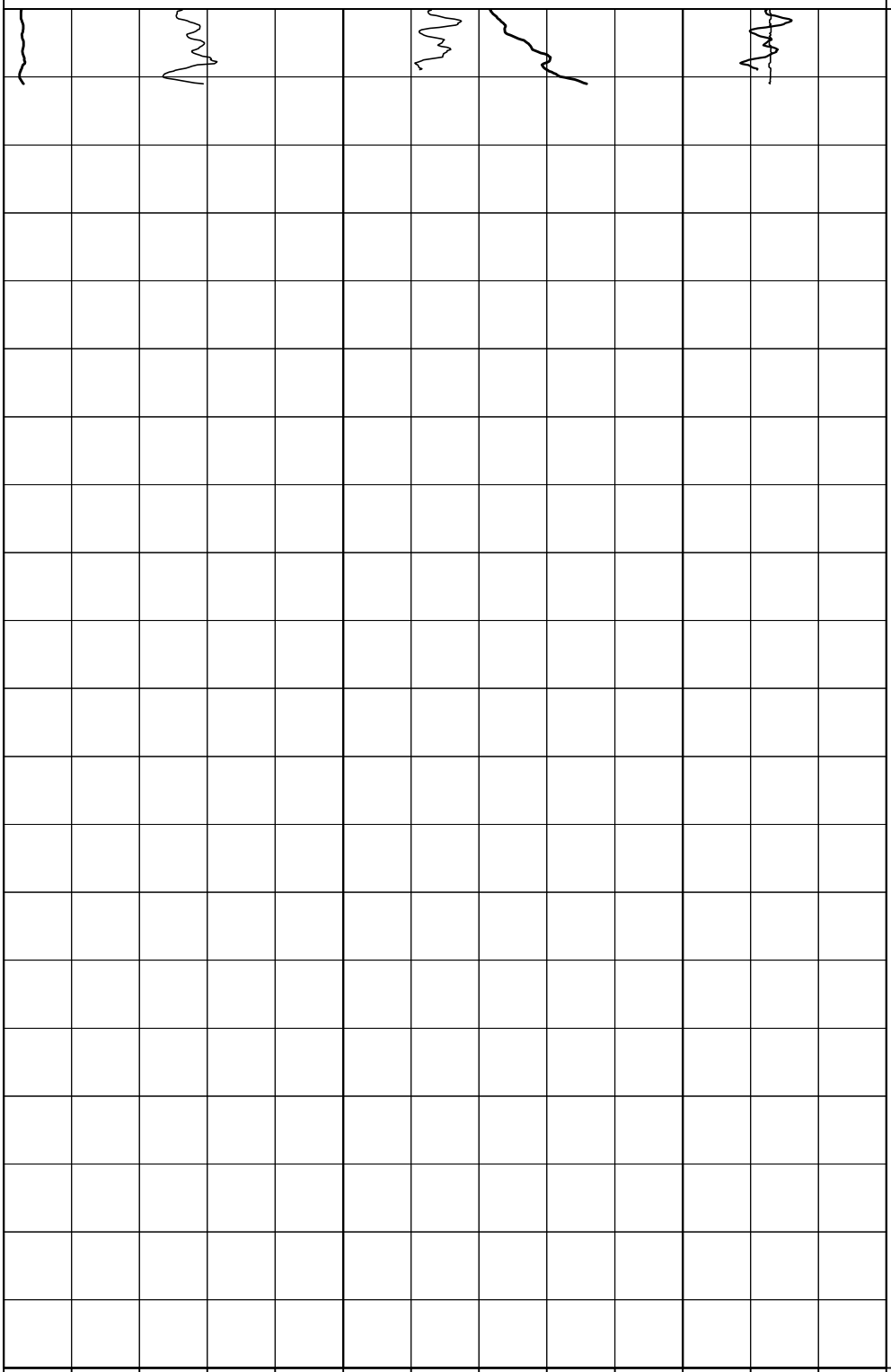

2 4 6 8 q_c (MPa)	0.1 0.2 0.3 0.4 f_s (MPa)	5 10 Incl. (°)	Depth (m)
20 40 60 80 q_c (MPa)	0.0 0.5 1.0 1.5 u (MPa)	2 4 R_f (%)	

E	: 390834,4	Cone no.	: 130705	Rig	: GEOScope
N	: 5907485,8	Cone type	: TSP	Performed by	: BVI/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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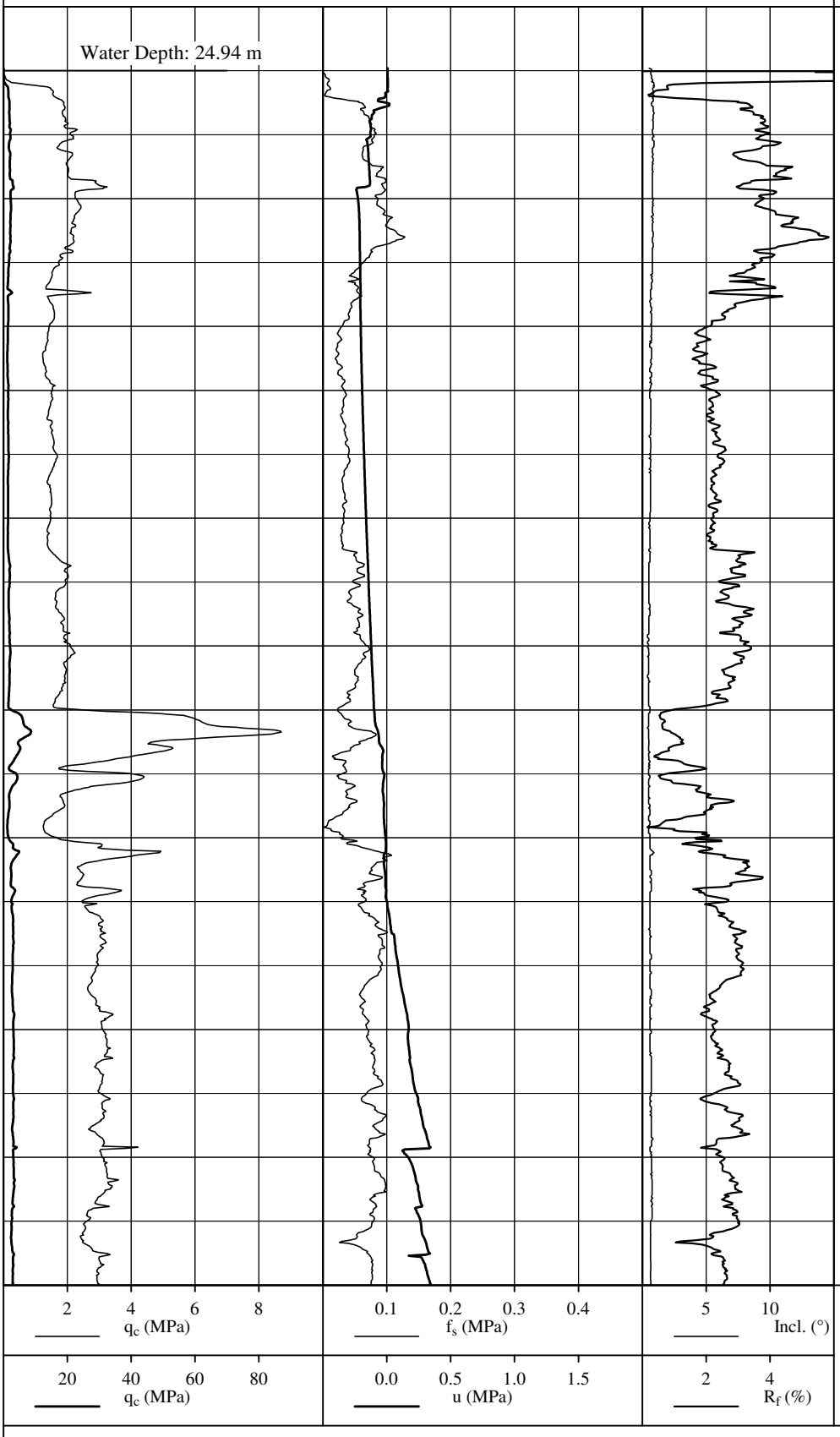
CPT name : ST14461-CPT23



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N	: 5906996,0	Cone type	: TSP	Performed by	: BVI/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max thrust

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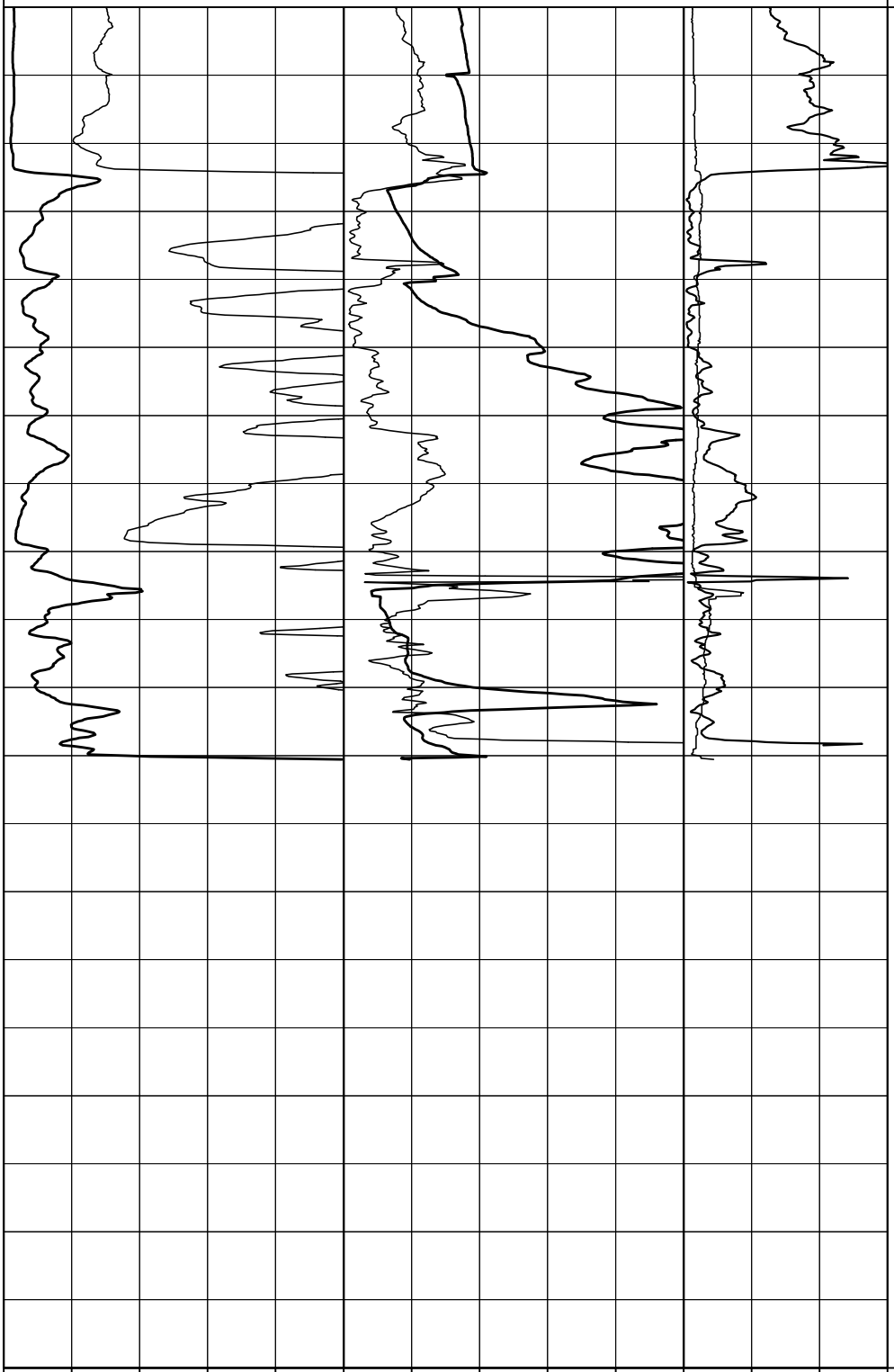
CPT name : ST14461-CPT23



2 4 6 8
q_c (MPa)

20 40 60 80
q_c (MPa)

0.1 0.2 0.3 0.4
f_s (MPa)

0.0 0.5 1.0 1.5
u (MPa)

5 10
Incl. (°)

2 4
R_f (%)

Depth (m)

E	: 391439,4	Cone no.	: 130705	Rig	: GEOScope
N	: 5906996,0	Cone type	: TSP	Performed by	: BVI/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max thrust

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Prepared	: BVI	Date: 2014-03-14	Subject: ST14461-CPT23	
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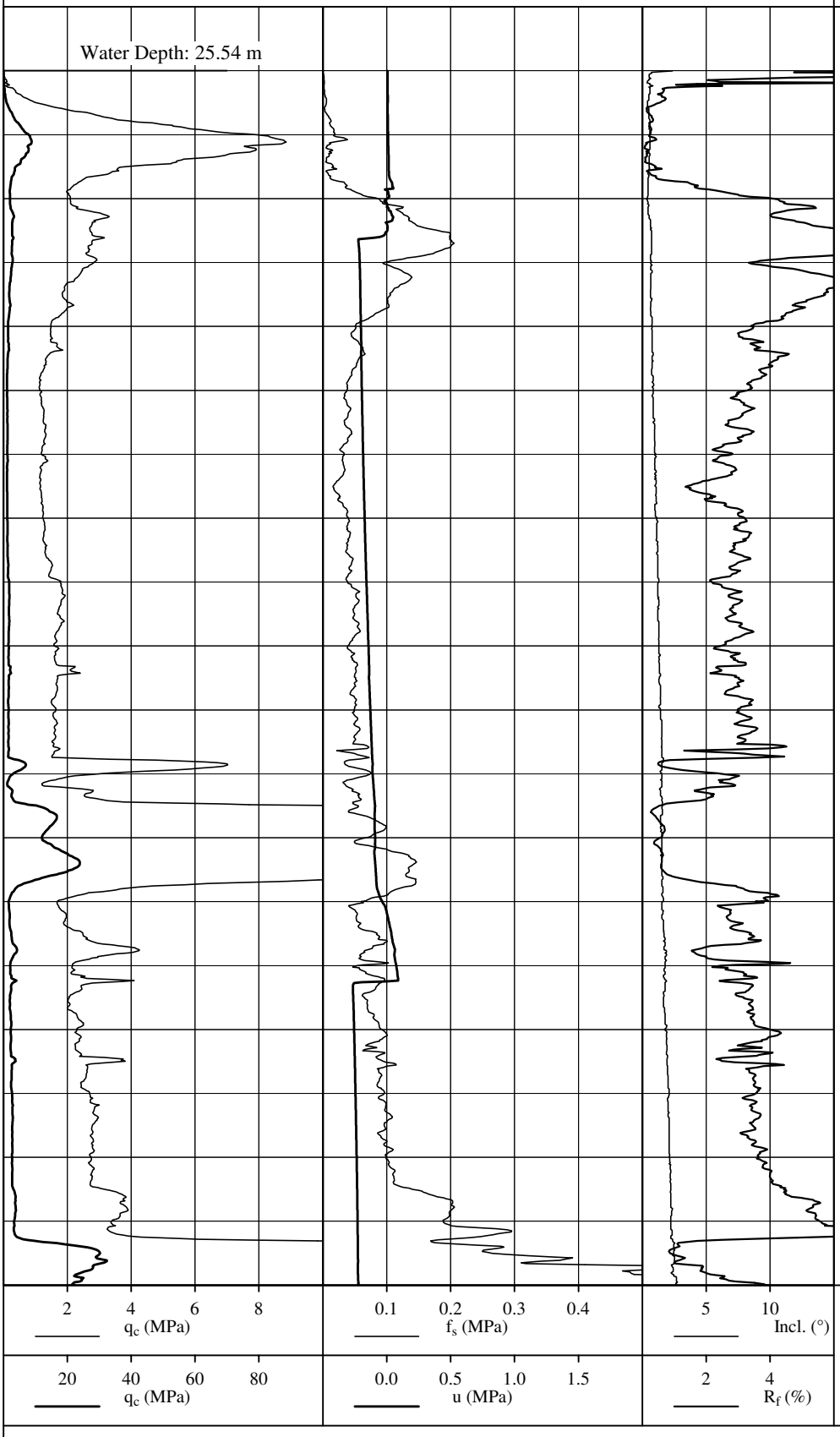
CPT name : ST14461-CPT24



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N	: 5906506,8	Cone type	: TSP	Performed by	: MLA/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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Prepared	: LEJ	Date: 2014-03-14	Subject: ST14461-CPT24		
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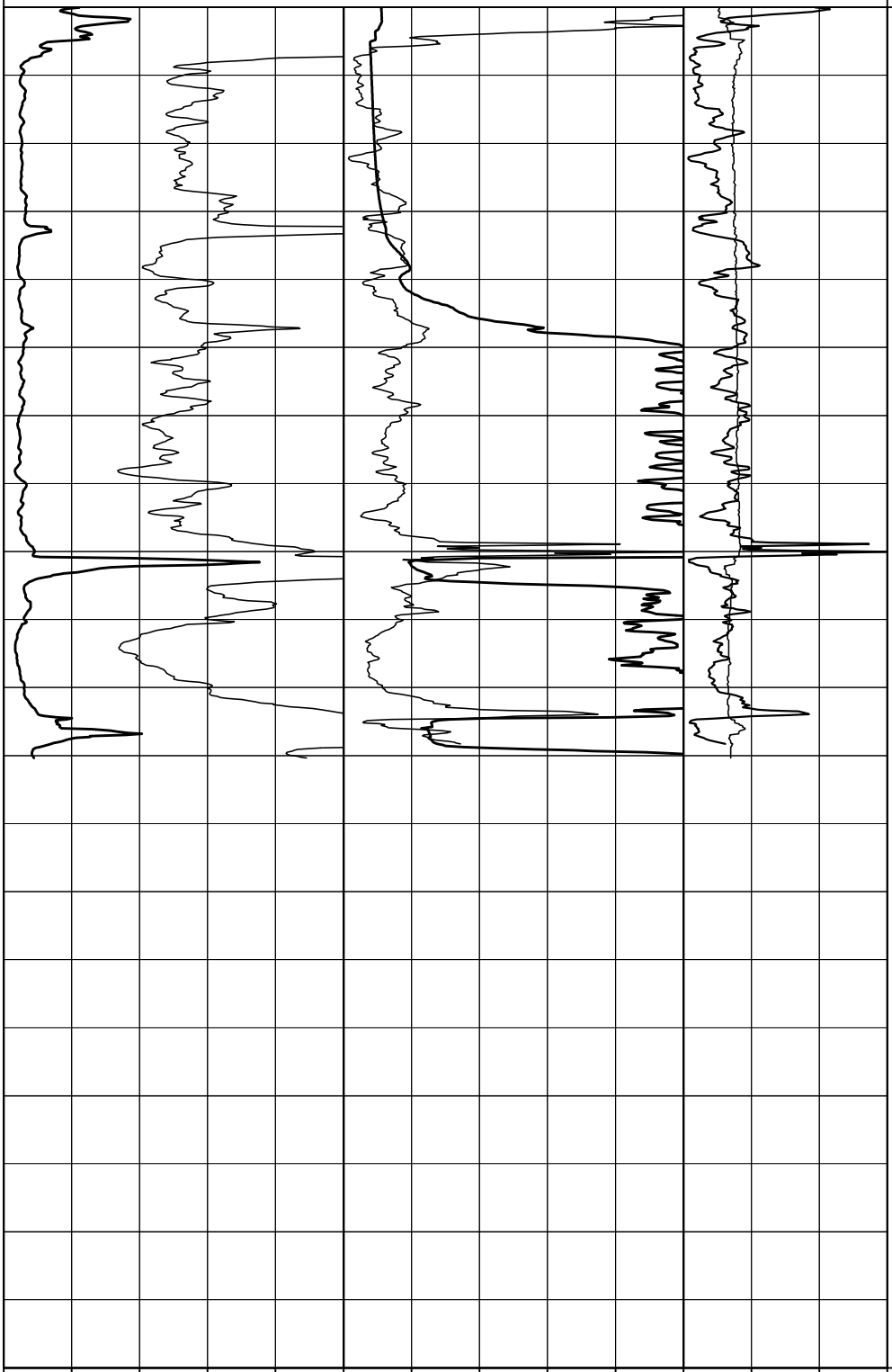
CPT name : ST14461-CPT24



2 4 6 8
q_c (MPa)

20 40 60 80
q_c (MPa)

0.1 0.2 0.3 0.4
f_s (MPa)

0.0 0.5 1.0 1.5
u (MPa)

5 10
Incl. (°)

2 4
R_f (%)

Depth (m)

E	: 392043,6	Cone no.	: 130706	Rig	: GEOScope
N	: 5906506,8	Cone type	: TSP	Performed by	: MLA/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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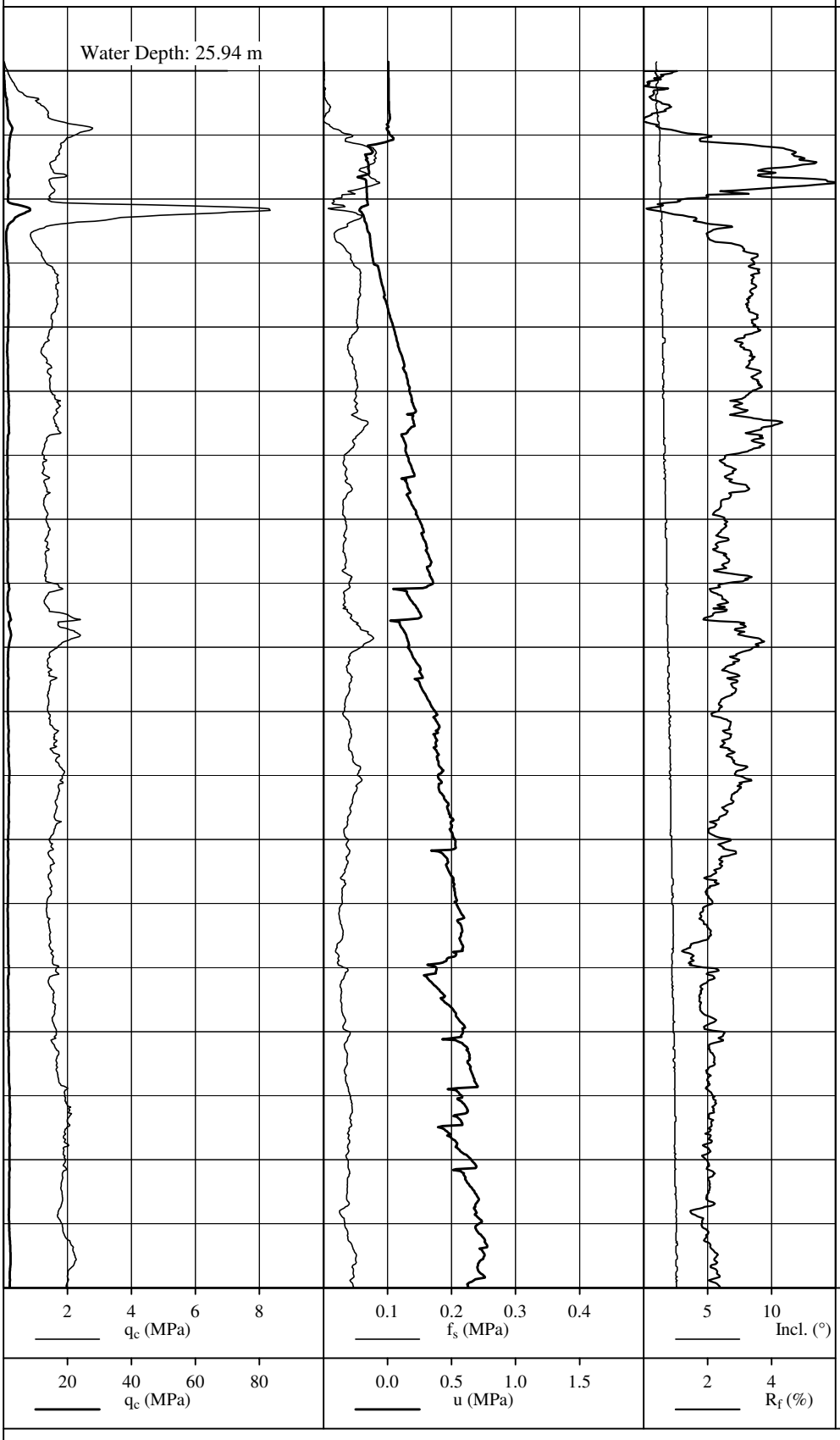
CPT name : ST14461-CPT26



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N	: 5905525,9	Cone type	: TSP	Performed by	: MLA/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Sudden 3°

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Prepared	: LEJ	Date: 2014-03-14	Subject: ST14461-CPT26	
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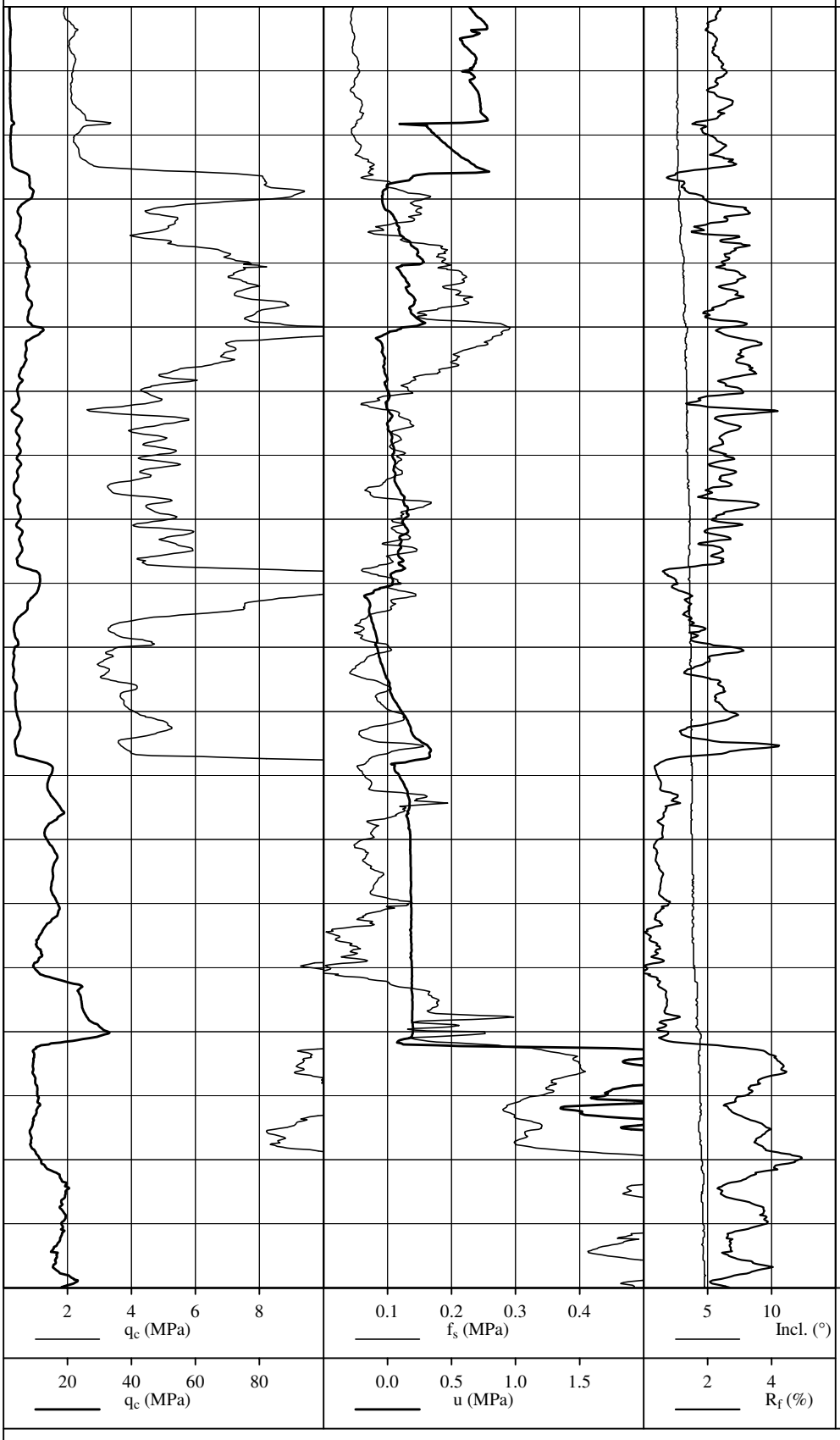
CPT name : ST14461-CPT26



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N	: 5905525,9	Cone type	: TSP	Performed by	: MLA/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Sudden 3°

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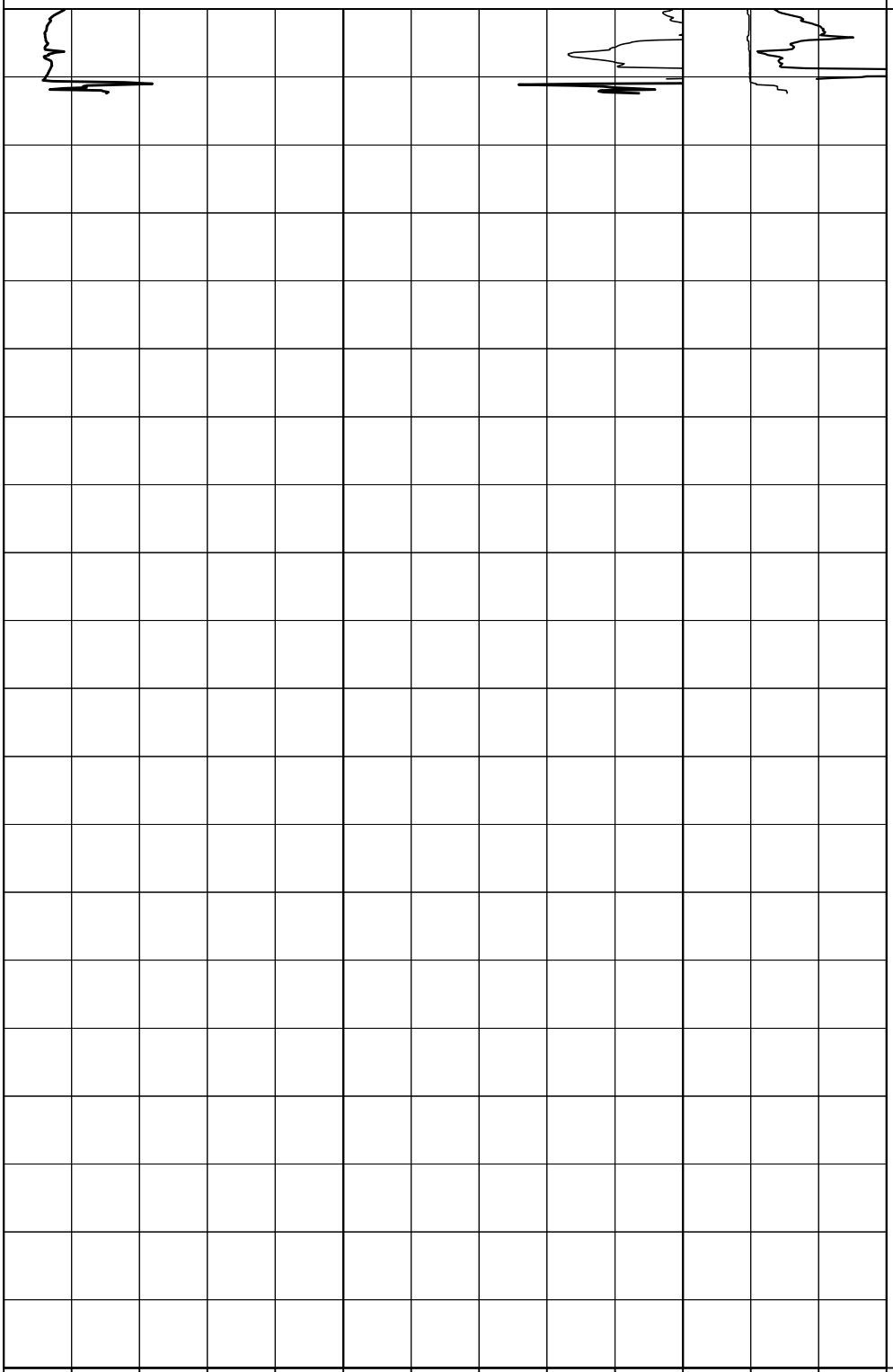
CPT name : ST14461-CPT26



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20 40 60 80 q_c (MPa)	0.0 0.5 1.0 1.5 u (MPa)	2 4 R_f (%)	

E	: 393255,1	Cone no.	: 130706	Rig	: GEOScope
N	: 5905525,9	Cone type	: TSP	Performed by	: MLA/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Sudden 3°

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Prepared	: LEJ	Date: 2014-03-14	Subject: ST14461-CPT26		
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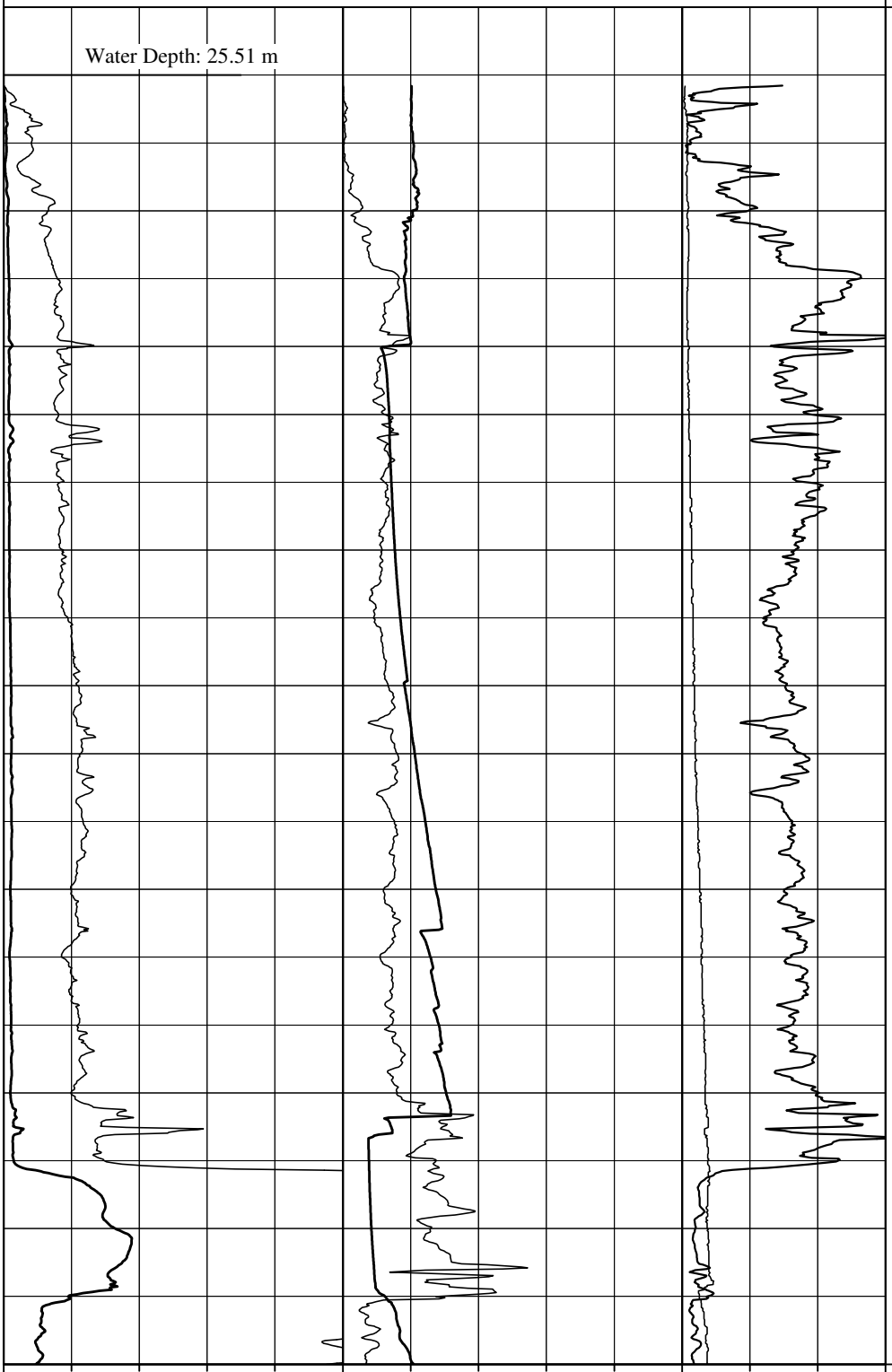
CPT name : ST14461-CPT27



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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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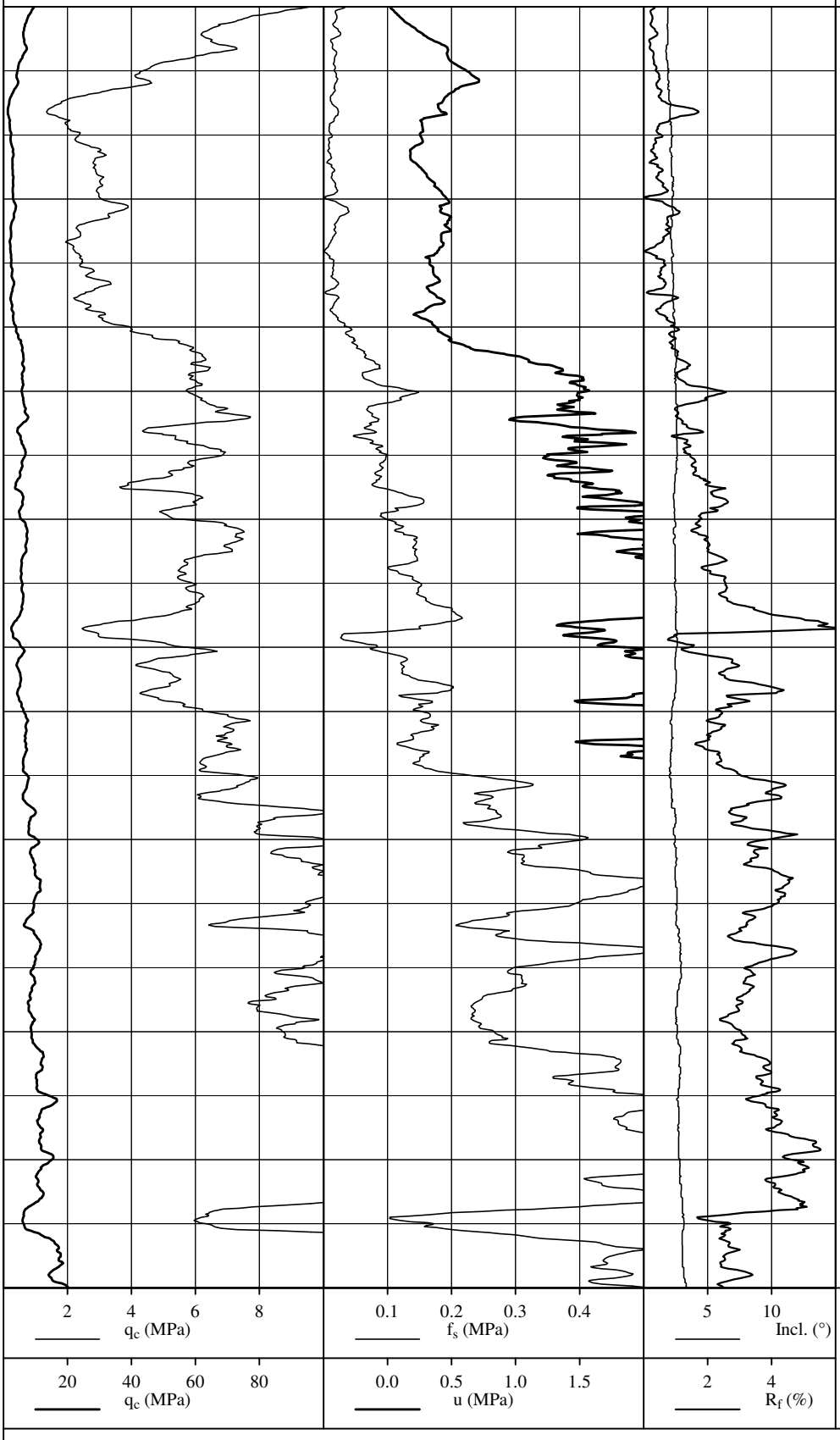
CPT name : ST14461-CPT27



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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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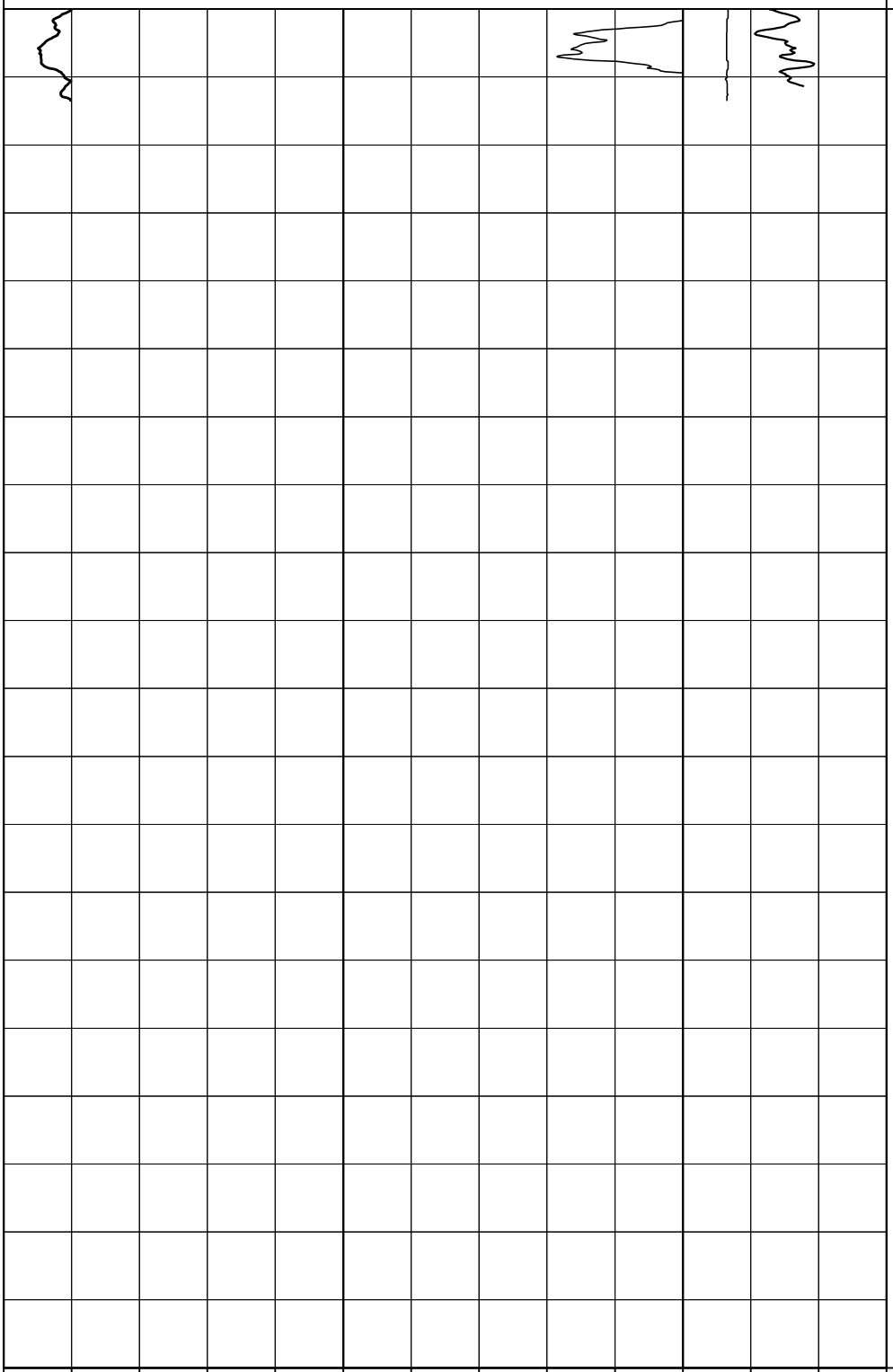

2 4 6 8 q_c (MPa)	0.1 0.2 0.3 0.4 f_s (MPa)	5 10 Incl. (°)	Depth (m)
20 40 60 80 q_c (MPa)	0.0 0.5 1.0 1.5 u (MPa)	2 4 R_f (%)	

E	: 393860.0	Cone no.	: 130706	Rig	: GEOScope
N	: 5905035.7	Cone type	: TSP	Performed by	: LEJ/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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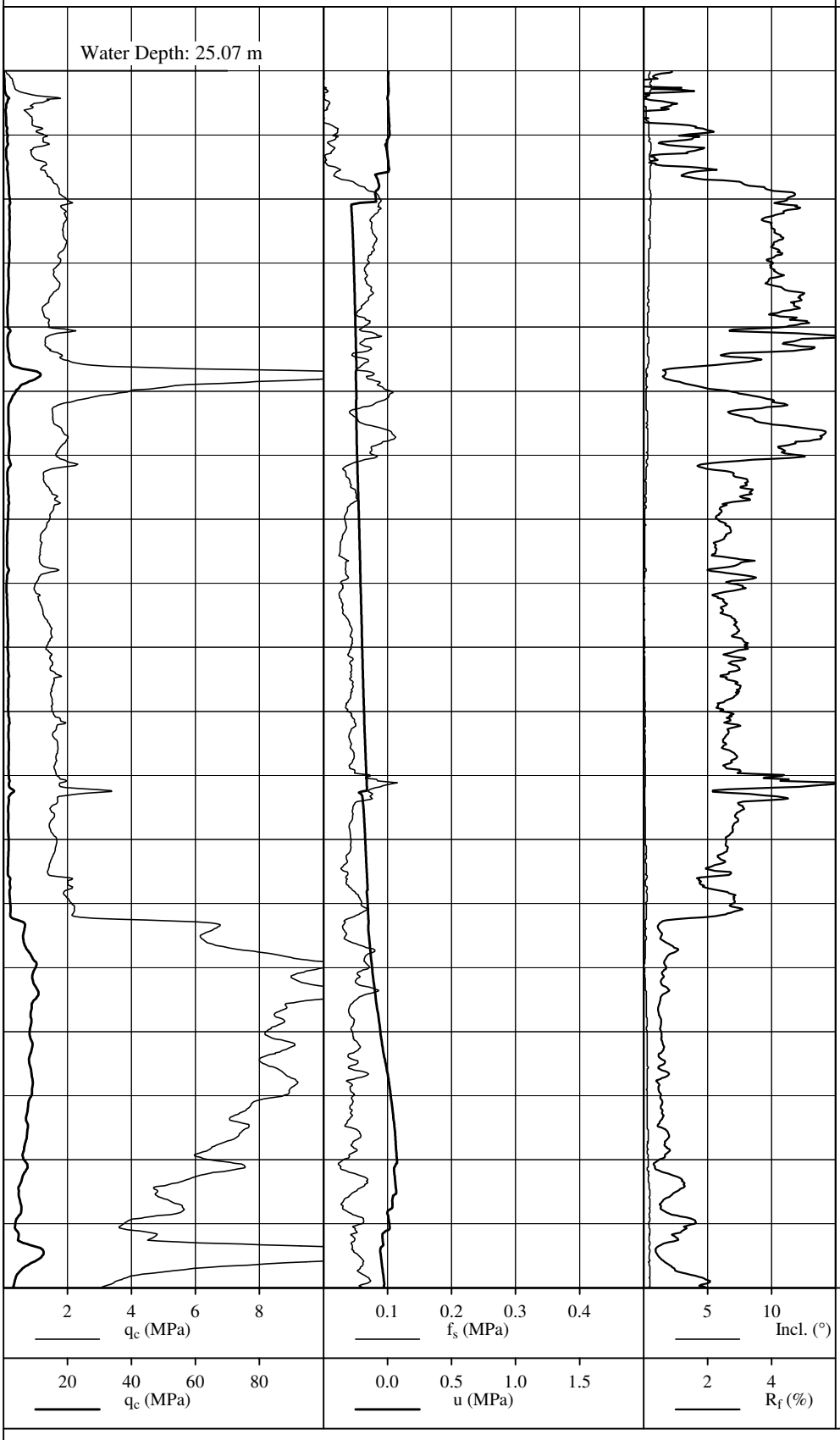
CPT name : ST14461-CPT28



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N	: 5904546.7	Cone type	: TSP	Performed by	: LEJ/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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Prepared	: JPM	Date : 2014-03-15	Subject: ST14461-CPT28		
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E	: 394465.2	Cone no.	: 130706	Rig	: GEOScope
N	: 5904546.7	Cone type	: TSP	Performed by	: LEJ/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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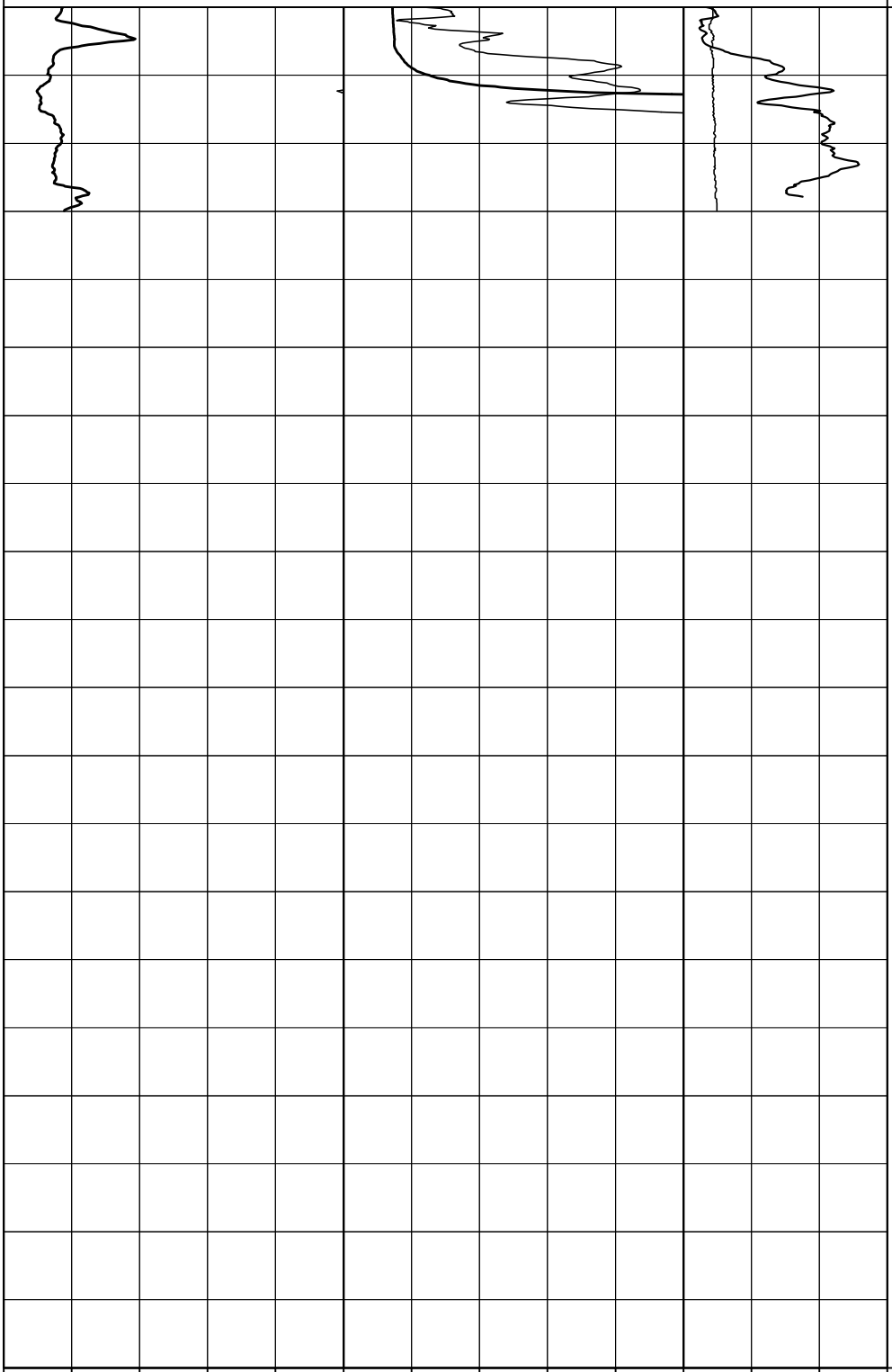
CPT name : ST14461-CPT28



2 4 6 8 q_c (MPa)	0.1 0.2 0.3 0.4 f_s (MPa)	5 10 Incl. (°)	Depth (m)
20 40 60 80 q_c (MPa)	0.0 0.5 1.0 1.5 u (MPa)	2 4 R_f (%)	

E	: 394465.2	Cone no.	: 130706	Rig	: GEOScope
N	: 5904546.7	Cone type	: TSP	Performed by	: LEJ/2014-03-14
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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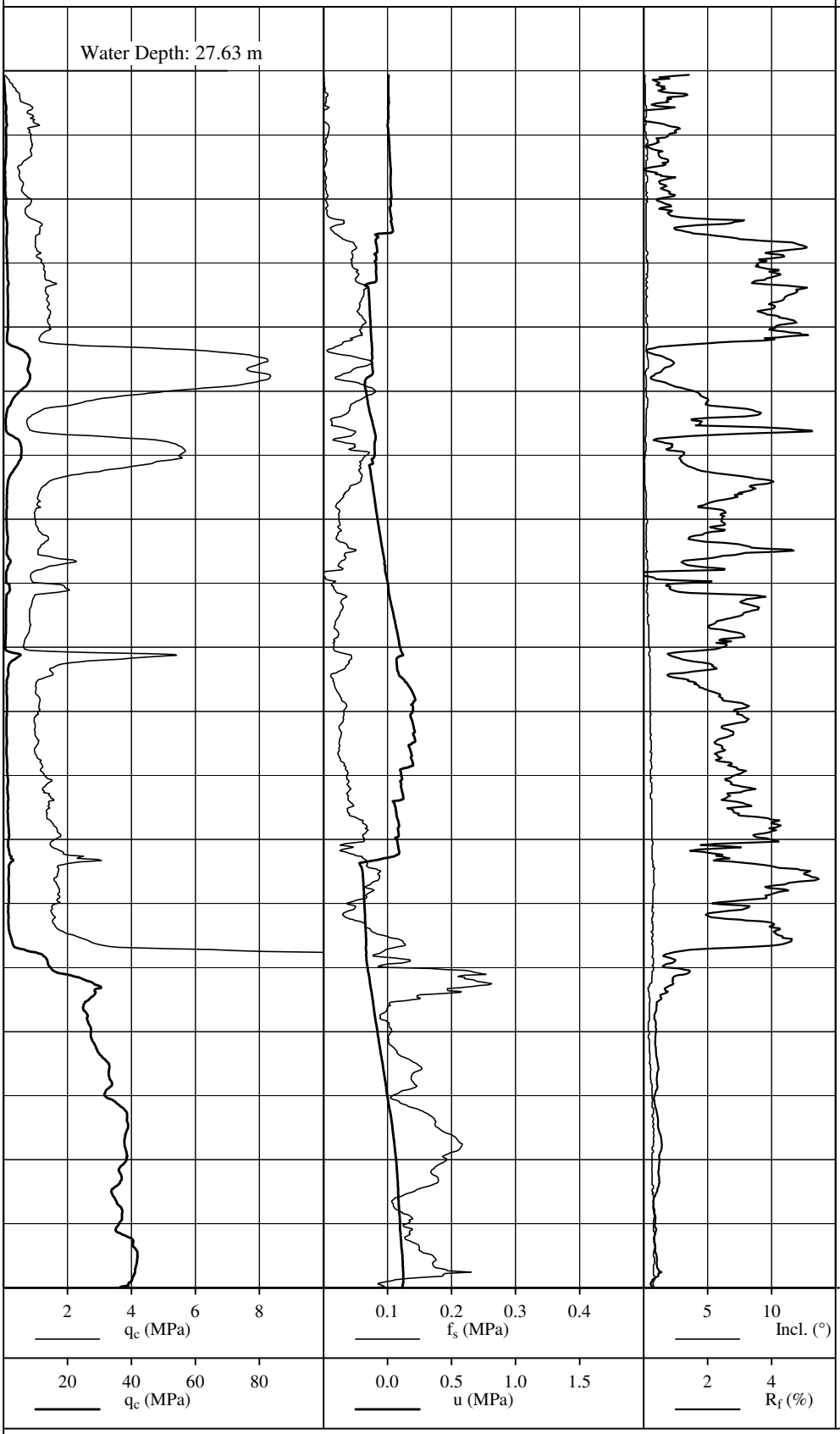
CPT name : ST14461-CPT29



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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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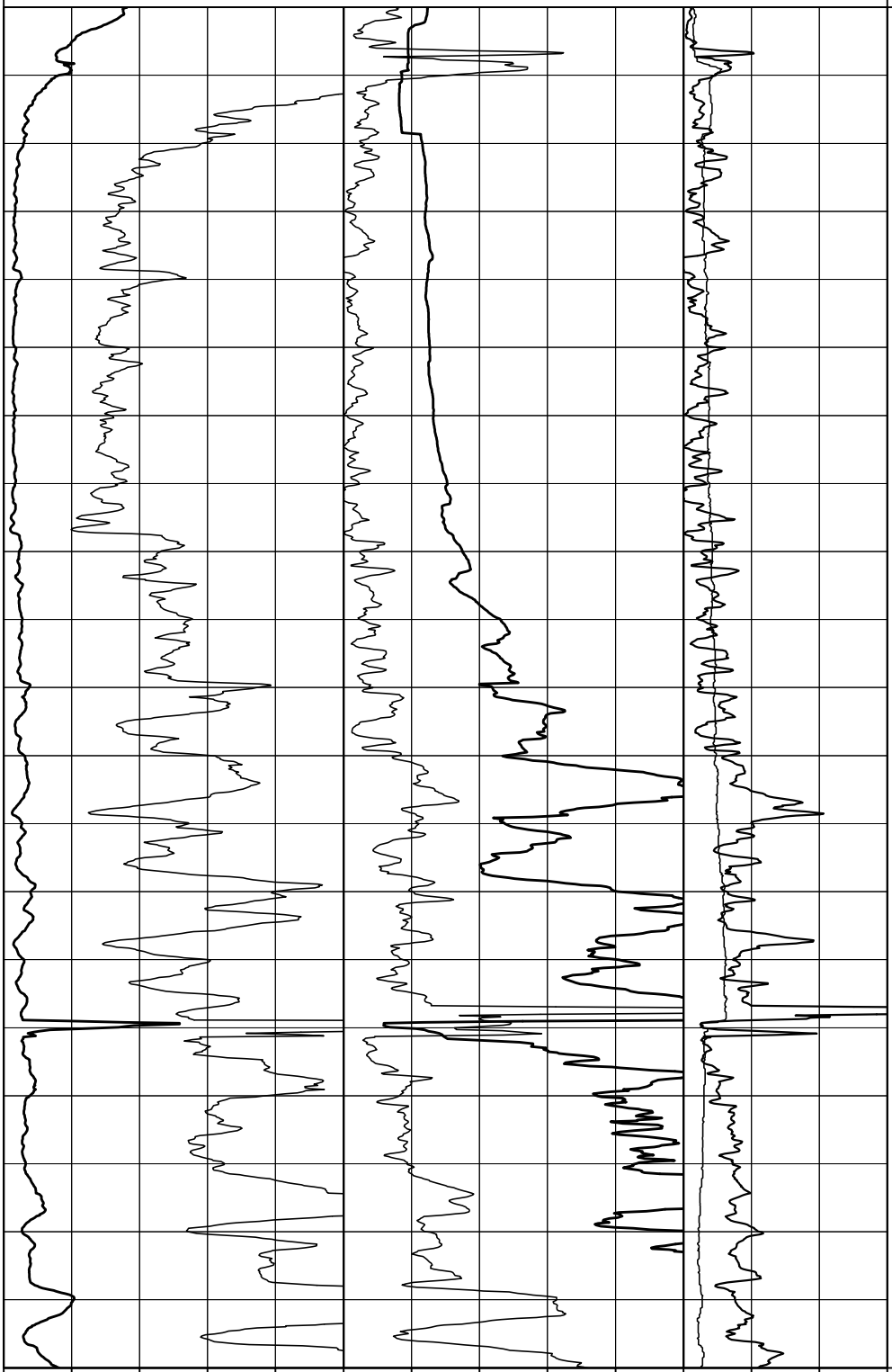
CPT name : ST14461-CPT29



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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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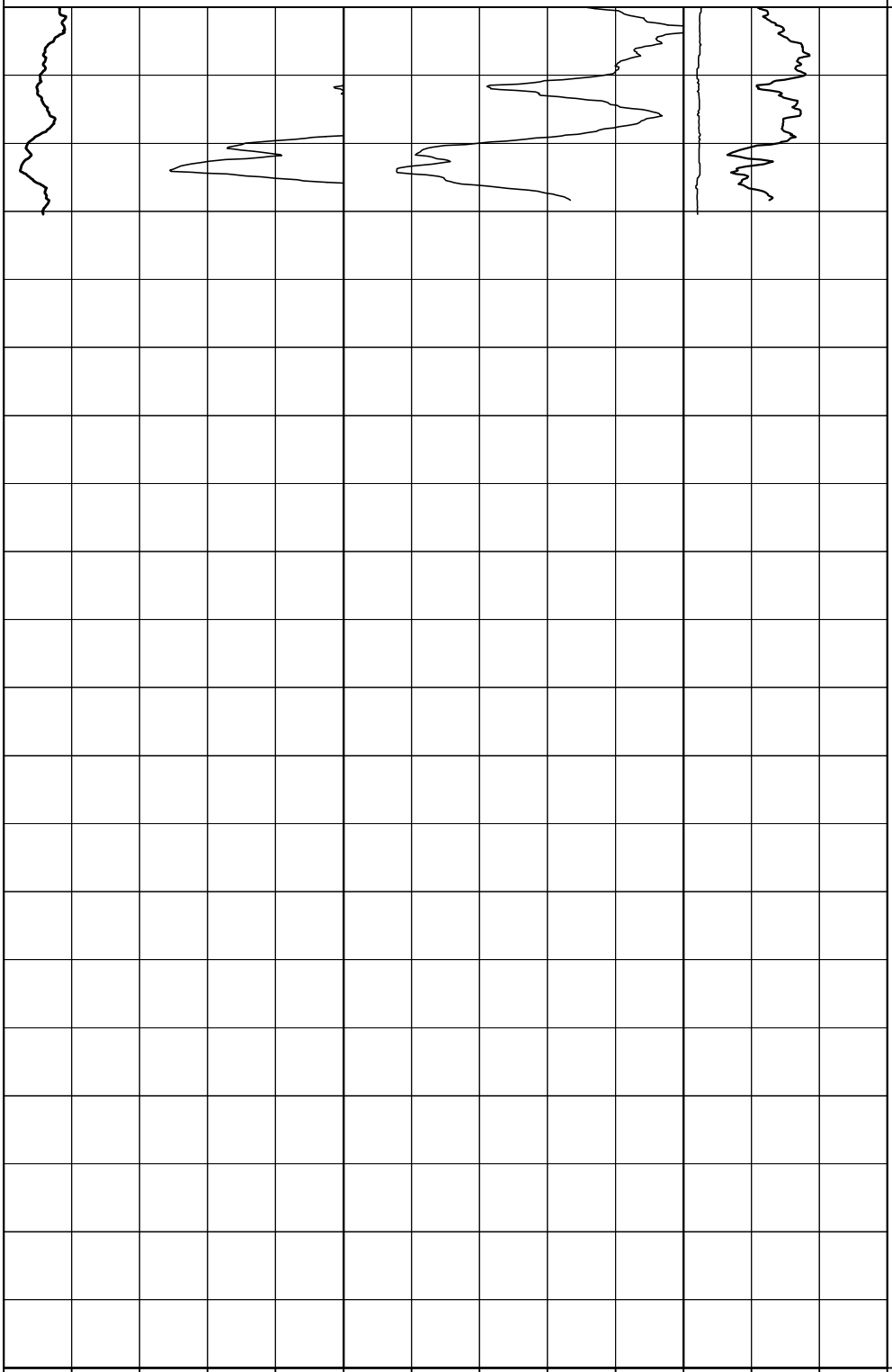
CPT name : ST14461-CPT29



2 4 6 8 q_c (MPa)	0.1 0.2 0.3 0.4 f_s (MPa)	5 10 Incl. (°)	Depth (m)
20 40 60 80 q_c (MPa)	0.0 0.5 1.0 1.5 u (MPa)	2 4 R_f (%)	

E	: 395069,2	Cone no.	: 130706	Rig	: GEOScope
N	: 5904055,7	Cone type	: TSP	Performed by	: JPM/2014-03-15
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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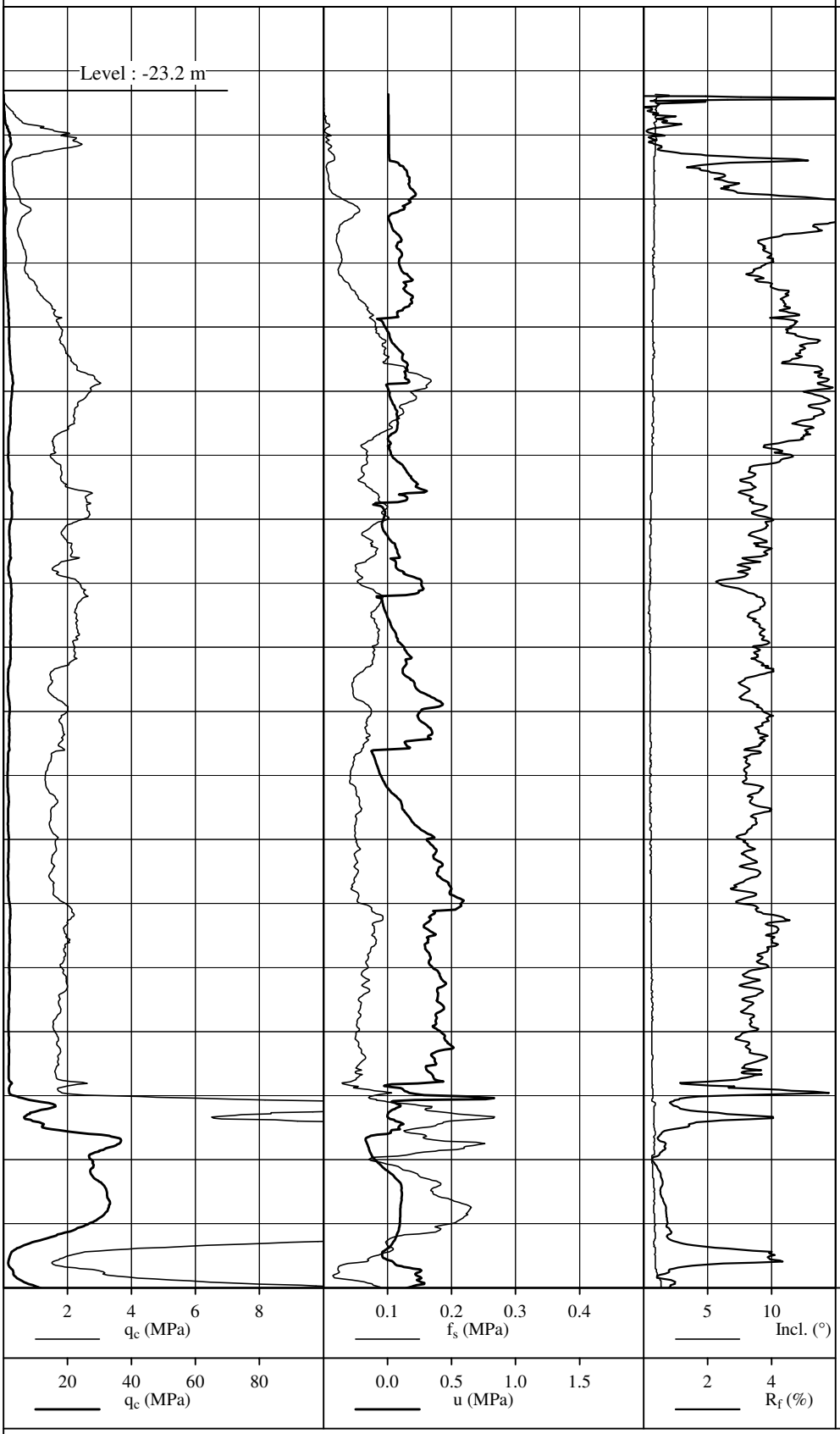
CPT name : ST14461-CPT3



E	: 393673.2	Cone no.	: 130811	Rig	: GEOScope
N	: 5898087.4	Cone type	: TSP	Performed by	: JPM/2014-03-13
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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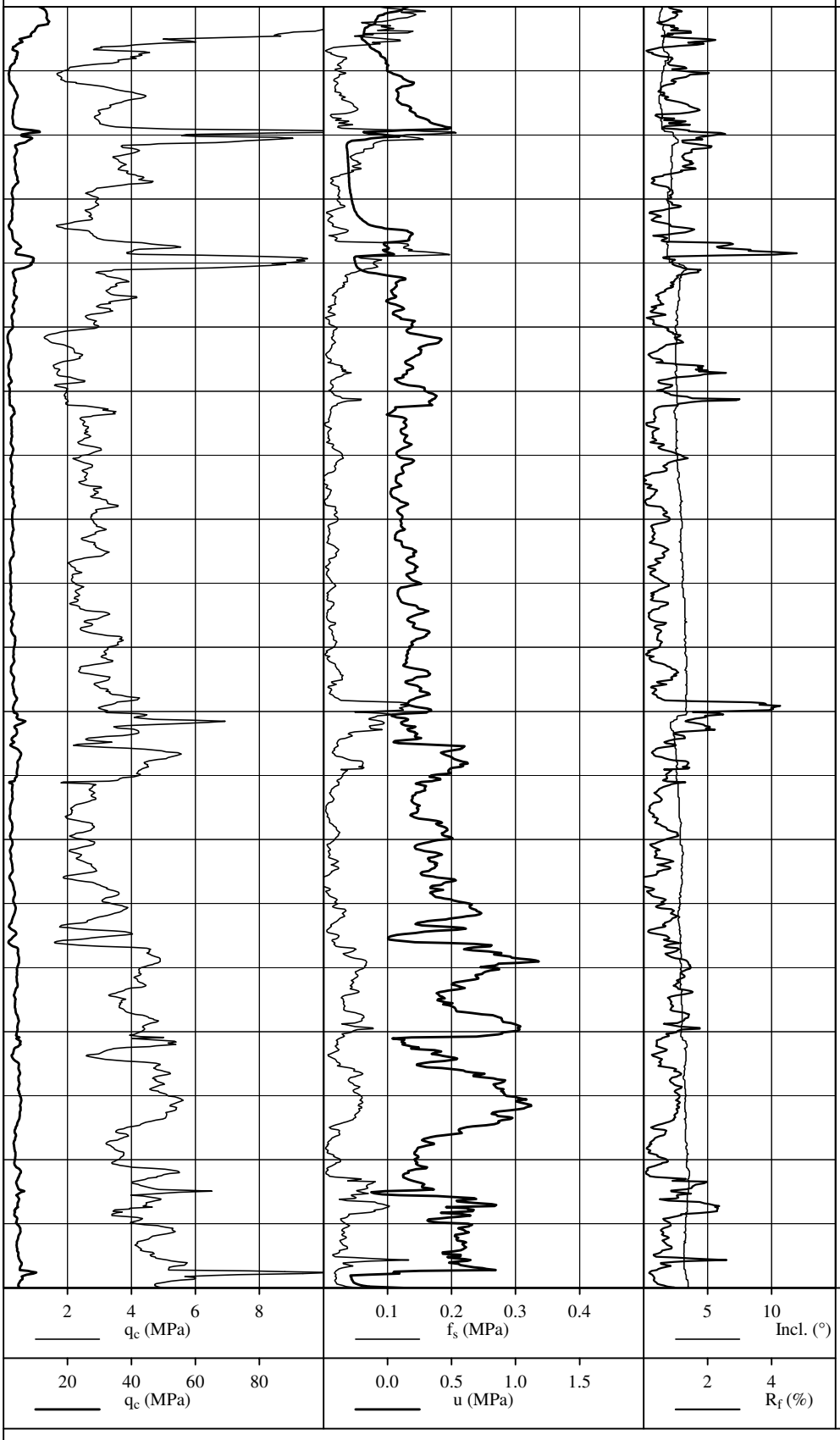
CPT name : ST14461-CPT3



E	: 393673.2	Cone no.	: 130811	Rig	: GEOScope
N	: 5898087.4	Cone type	: TSP	Performed by	: JPM/2014-03-13
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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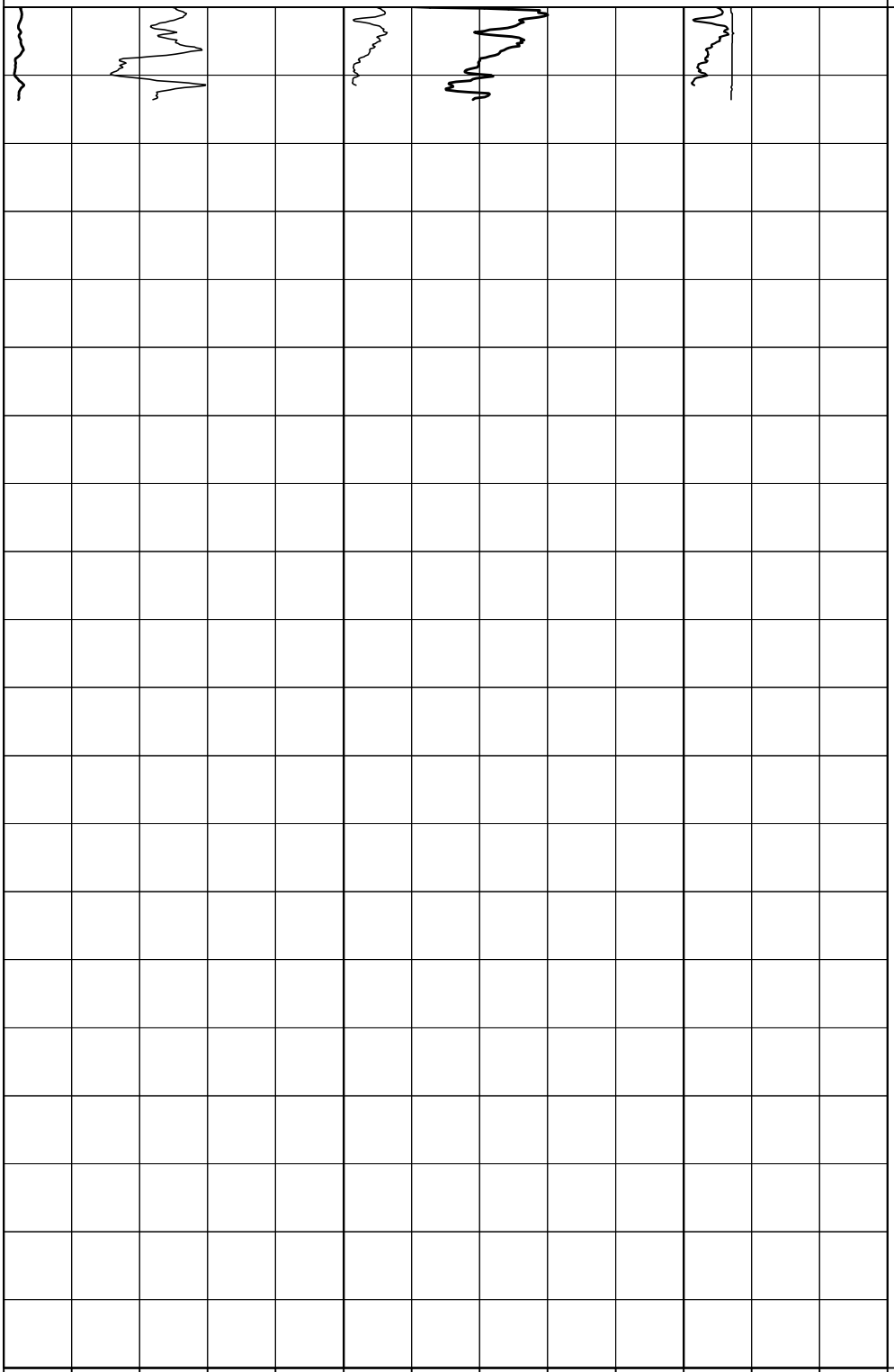
CPT name : ST14461-CPT3



E	: 393673.2	Cone no.	: 130811	Rig	: GEOScope
N	: 5898087.4	Cone type	: TSP	Performed by	: JPM/2014-03-13
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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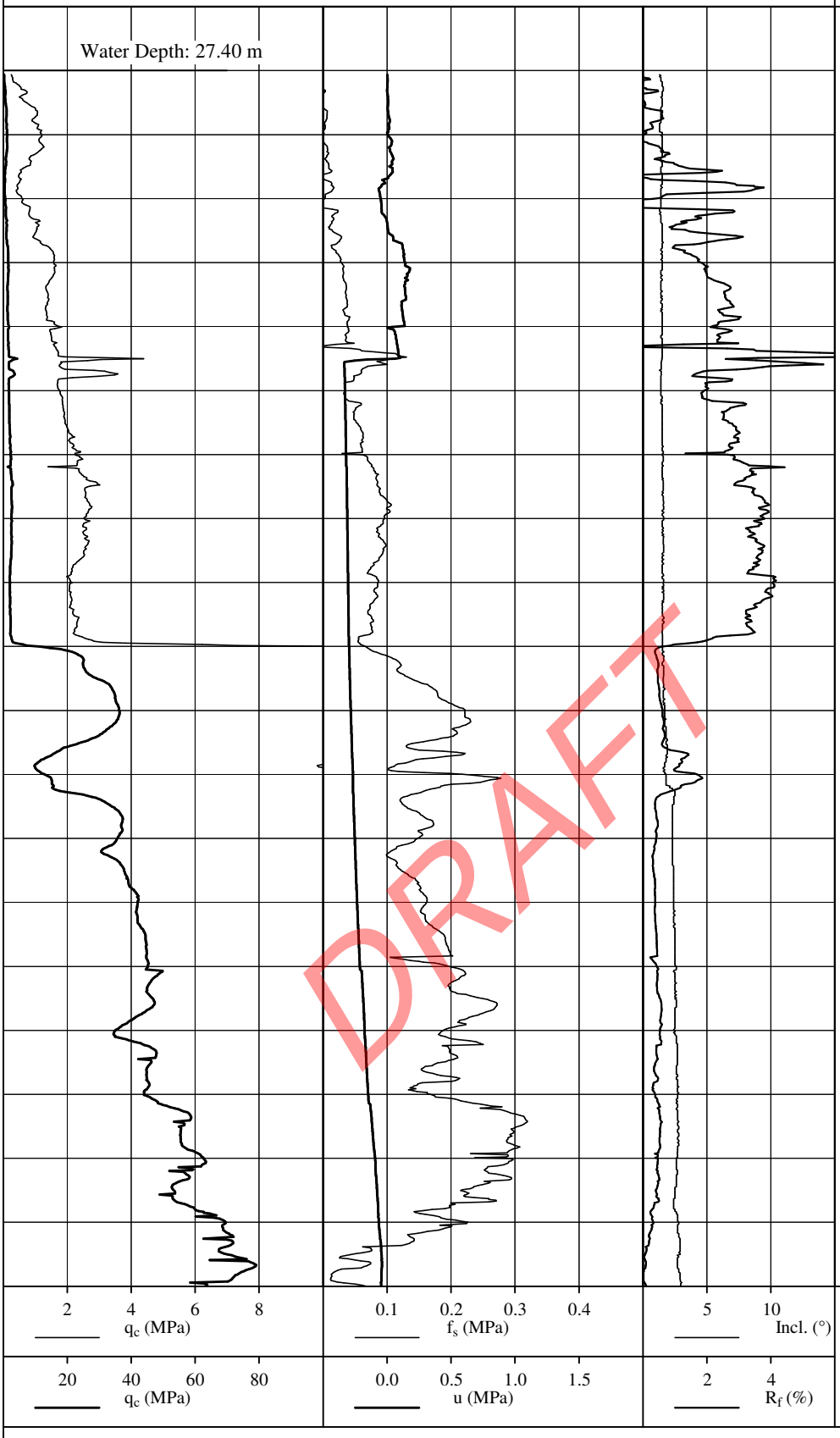
CPT name : ST14461-CPT32



E	: 396224,8	Cone no.	: 130706	Rig	: GEOScope
N	: 5902258,2	Cone type	: TSP	Performed by	: JPM/2014-03-22
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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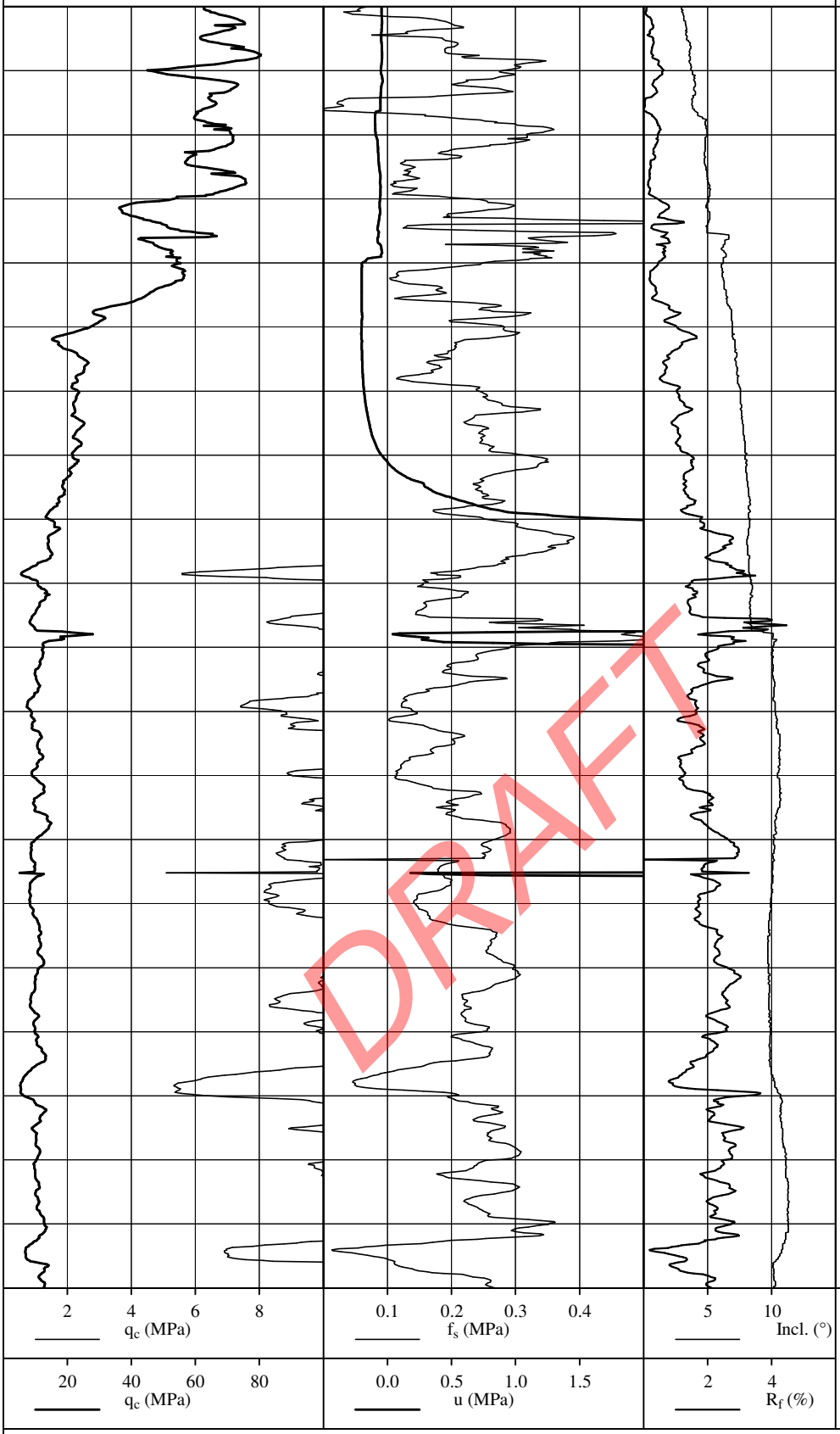
CPT name : ST14461-CPT32



E	: 396224,8	Cone no.	: 130706	Rig	: GEOScope
N	: 5902258,2	Cone type	: TSP	Performed by	: JPM/2014-03-22
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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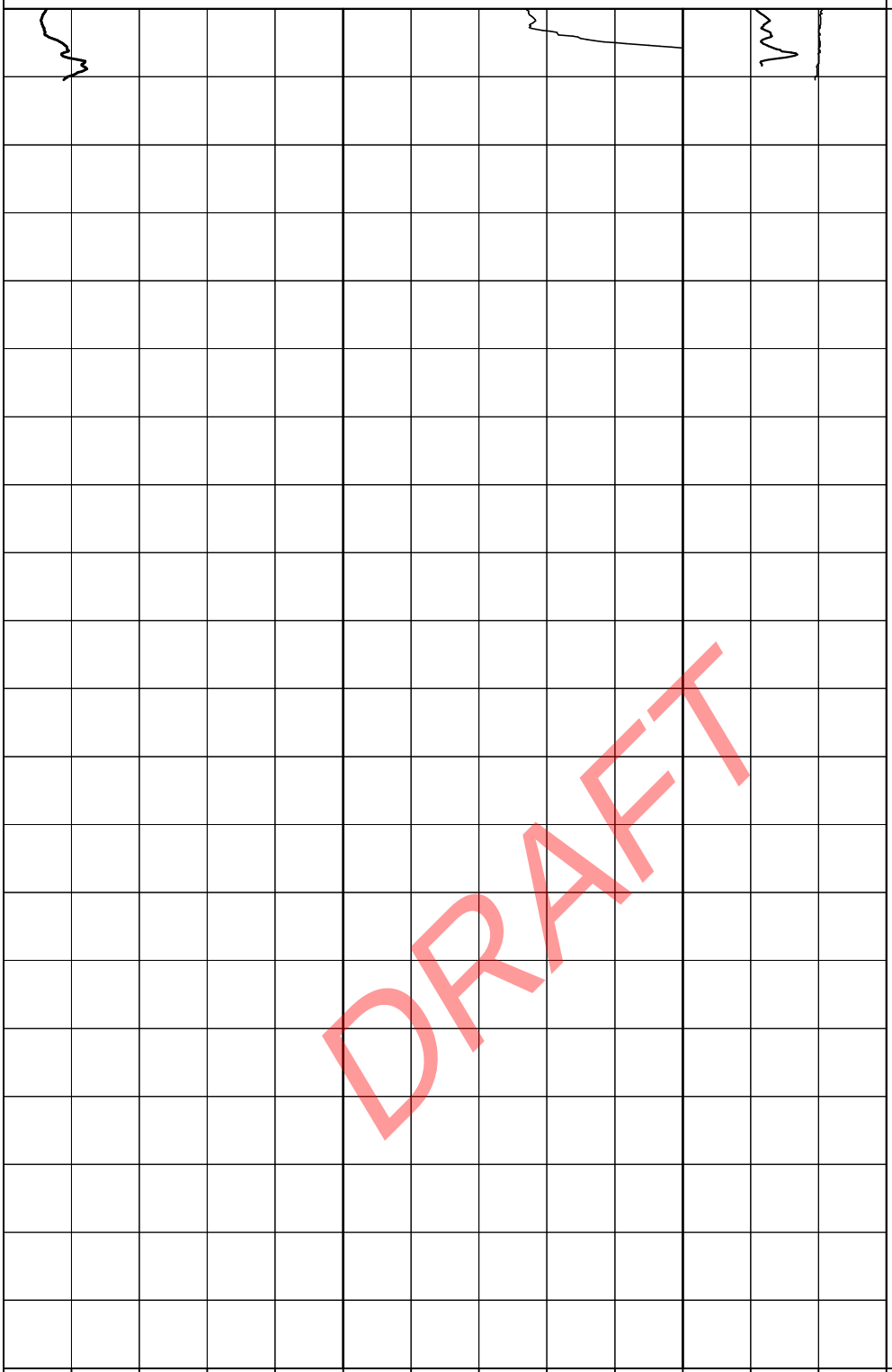
CPT name : ST14461-CPT32



2 4 6 8	0.1 0.2 0.3 0.4	5 10	Depth (m)
q_c (MPa)	f_s (MPa)	Incl. (°)	
20 40 60 80	0.0 0.5 1.0 1.5	2 4	
q_c (MPa)	u (MPa)	R_f (%)	

E	: 396224,8	Cone no.	: 130706	Rig	: GEOScope
N	: 5902258,2	Cone type	: TSP	Performed by	: JPM/2014-03-22
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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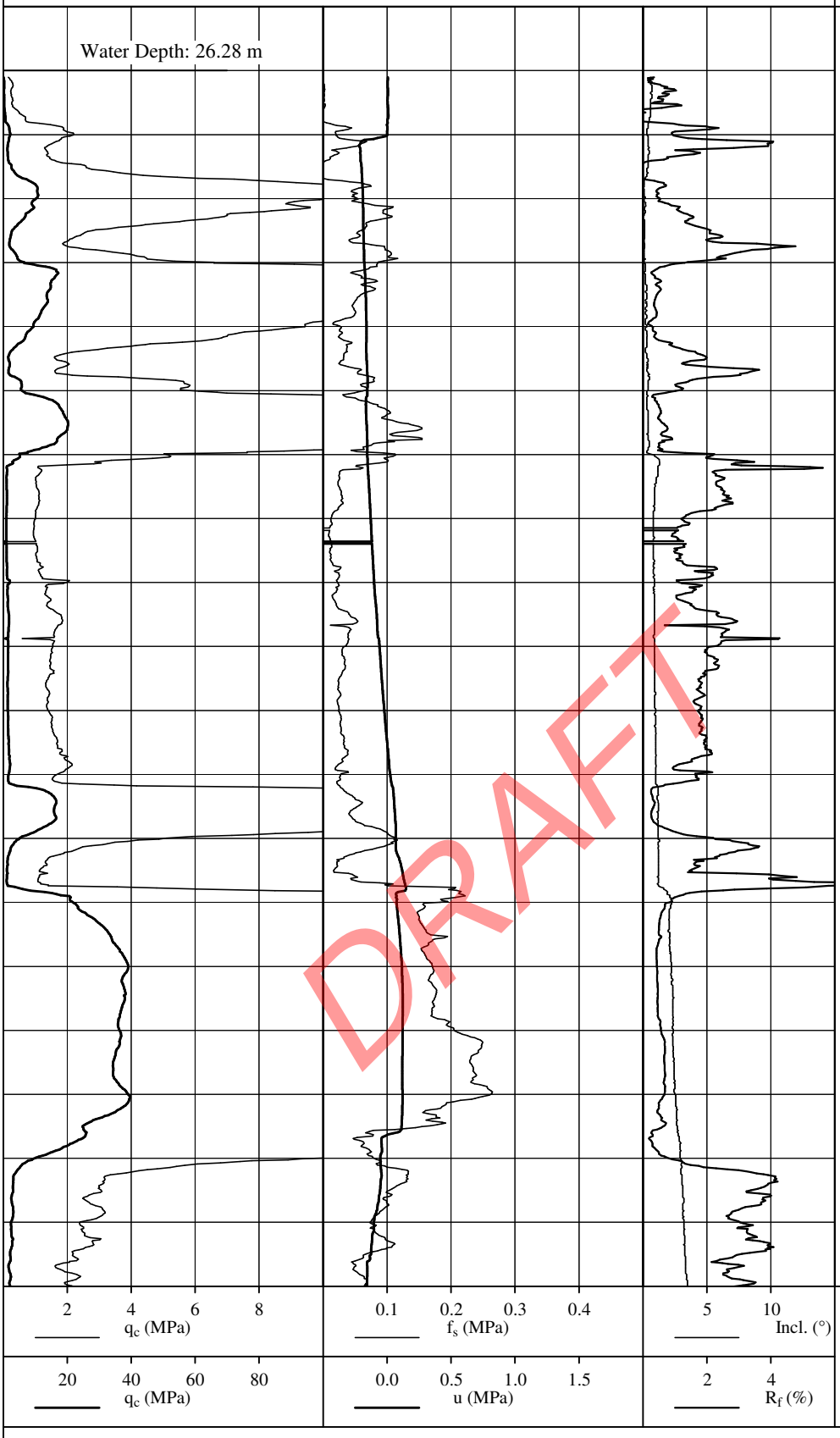
CPT name : ST14461-CPT33



E	:	Cone no.	: 130706	Rig	: GEOScope
N	:	Cone type	: TSP	Performed by	: JPM/2014-03-22
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max thrust

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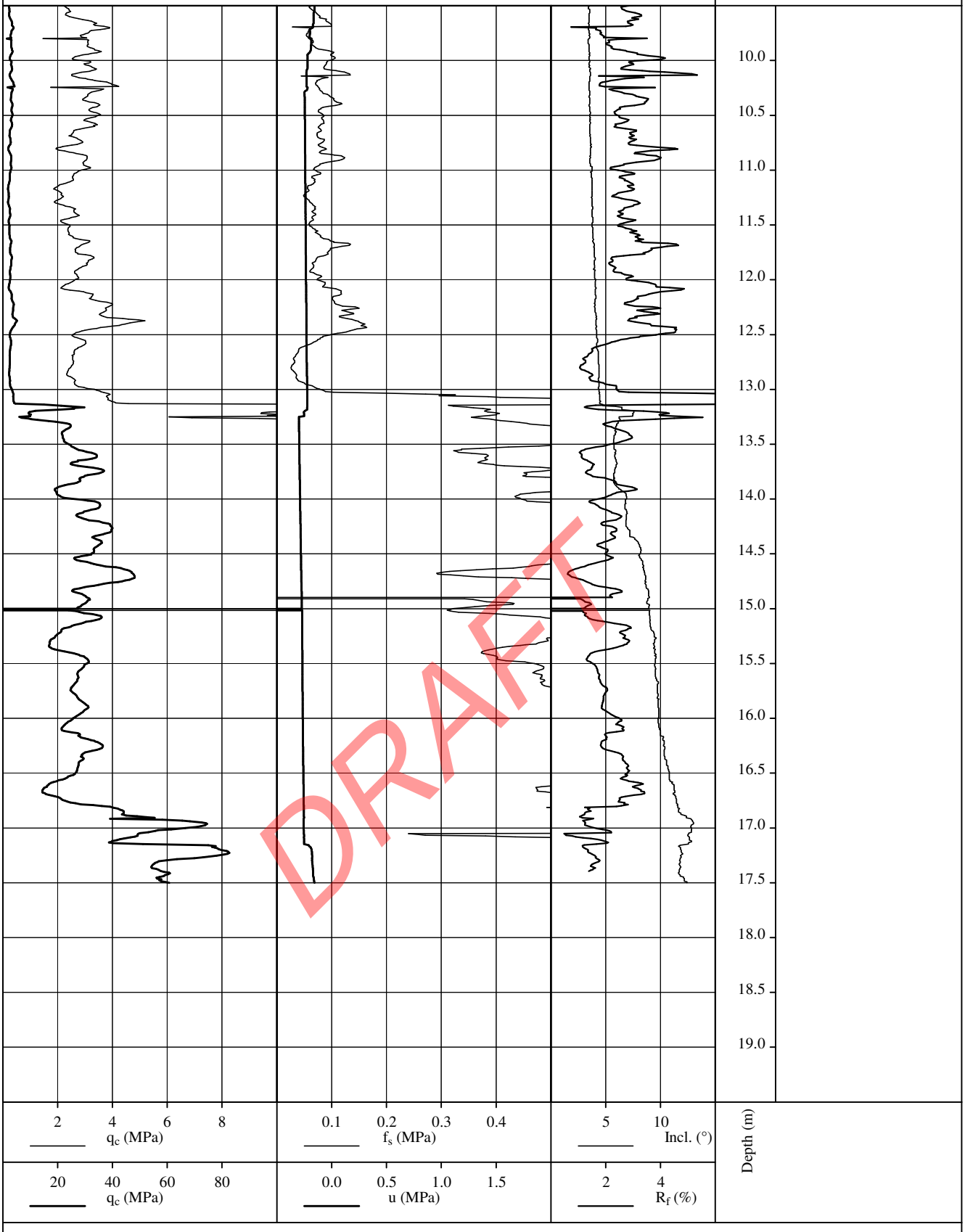
CPT name : ST14461-CPT33



E	:	Cone no.	: 130706	Rig	: GEOScope
N	:	Cone type	: TSP	Performed by	: JPM/2014-03-22
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max thrust

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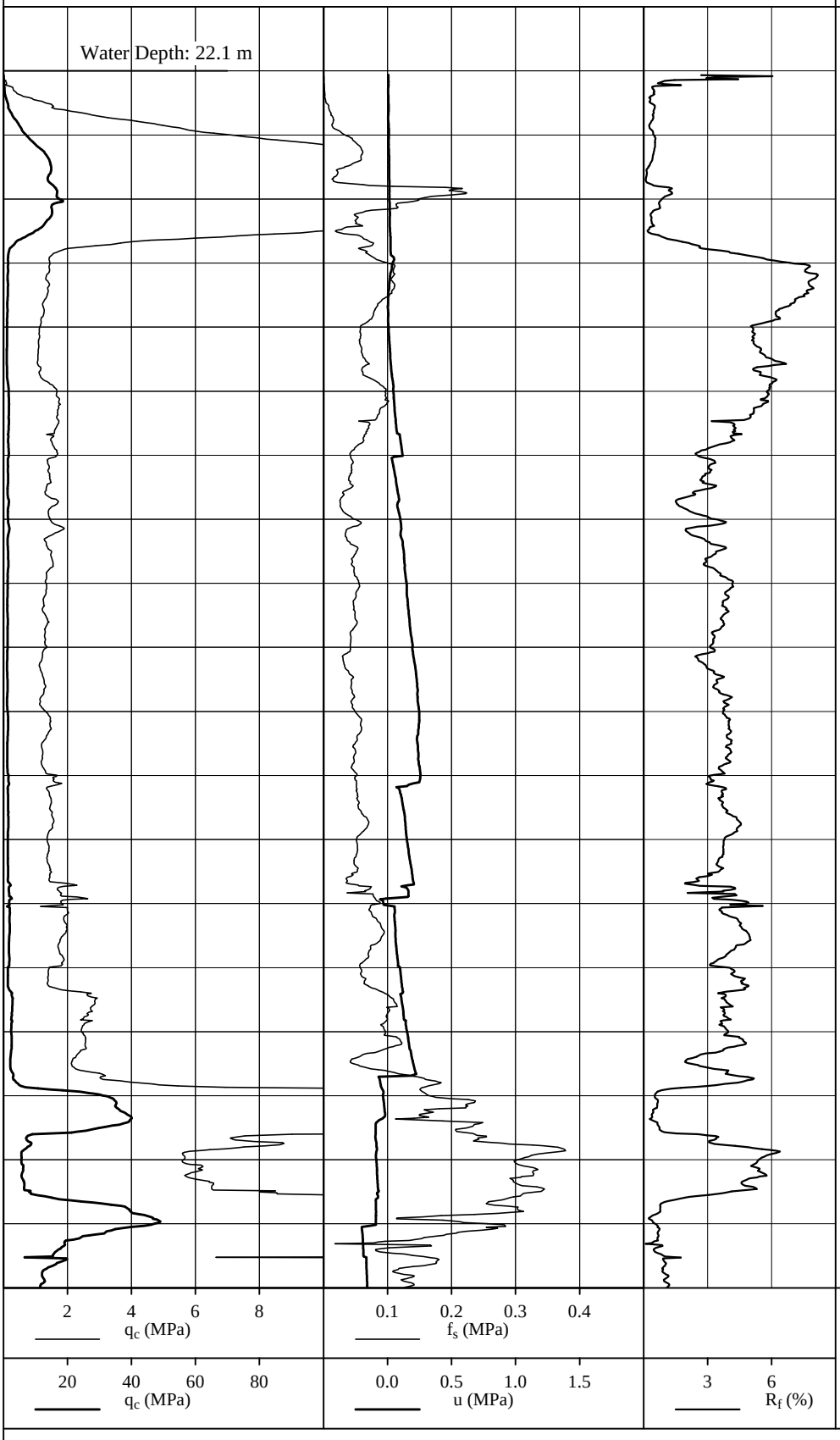
CPT name : ST14461-CPT34



E	: 394843.7	Cone no.	: 130706	Rig	: GEOScope
N	: 5898551.3	Cone type	: TSP	Performed by	: JPM/2014-03-18 00:05:49
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Sudden Incl

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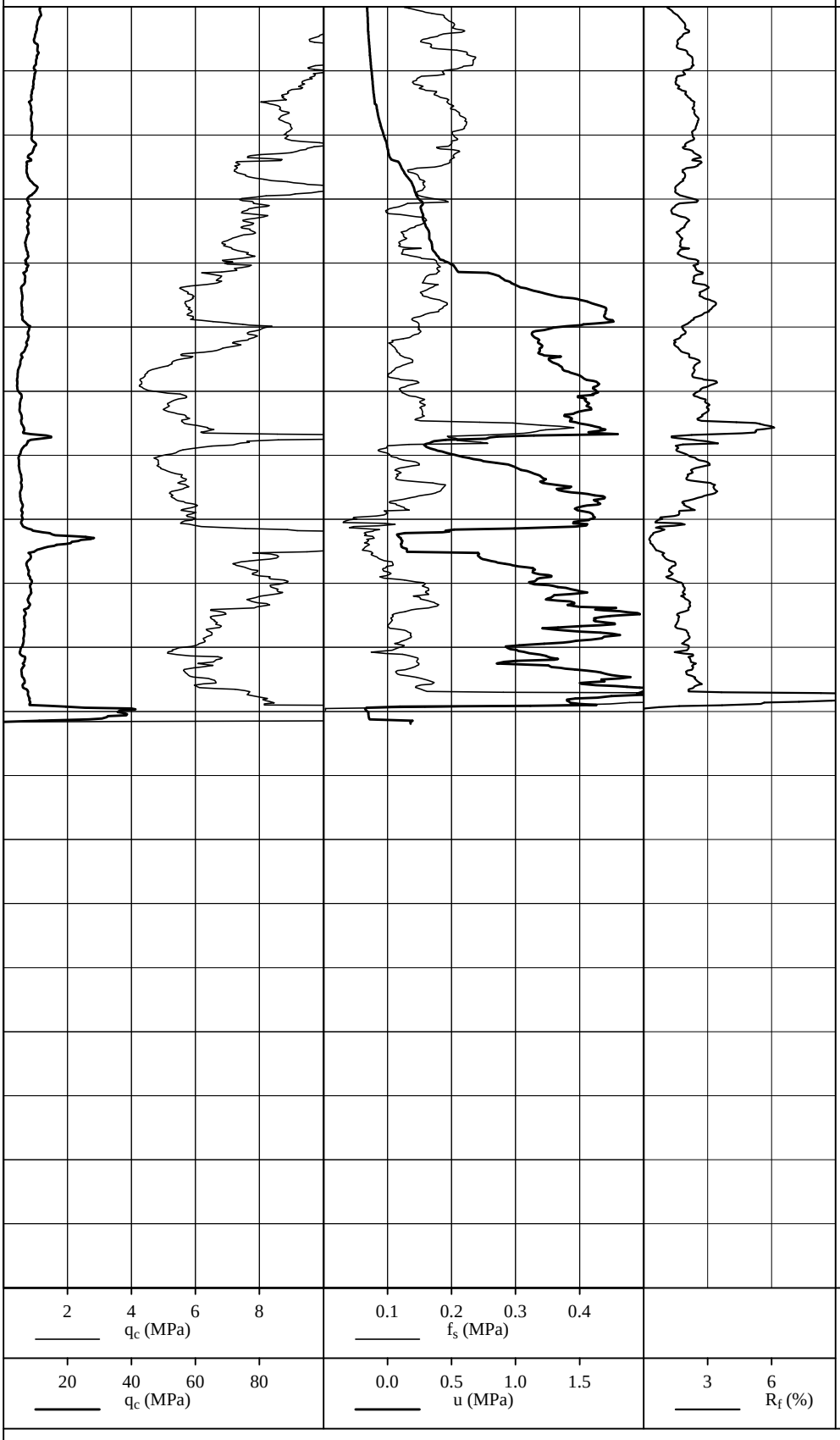
CPT name : ST14461-CPT34



E	: 394843.7	Cone no.	: 130706	Rig	: GEOScope
N	: 5898551.3	Cone type	: TSP	Performed by	: JPM/2014-03-18 00:05:49
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Sudden Incl

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Prepared	: JPM	Date: 2014-03-18	Subject: ST14461-CPT34	
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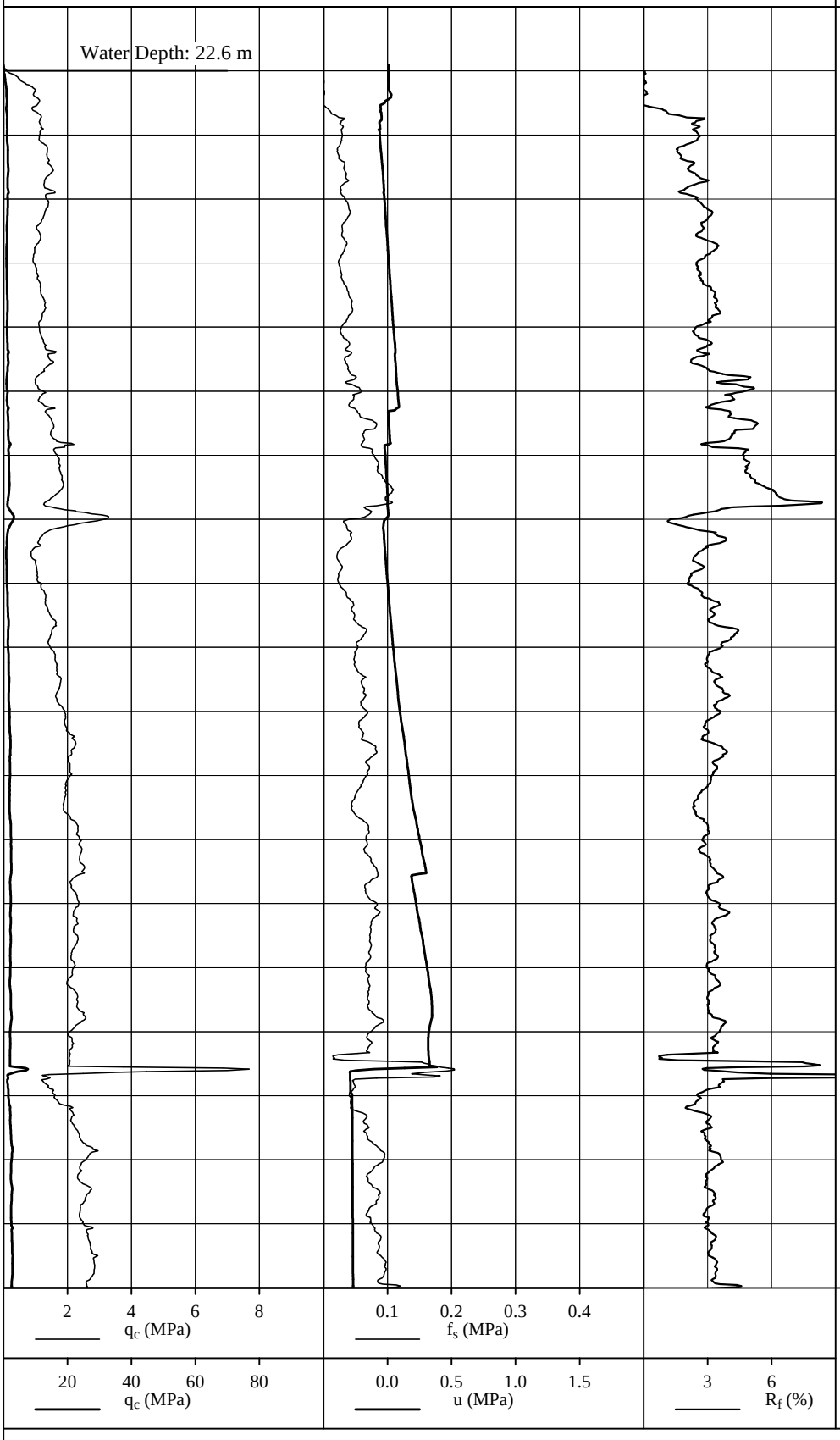
CPT name : ST14461-CPT36



E	: 393370,3	Cone no.	: 130707	Rig	: GEOScope
N	: 5899741,7	Cone type	: TSP	Performed by	: JPM/2014-03-18 03:47:52
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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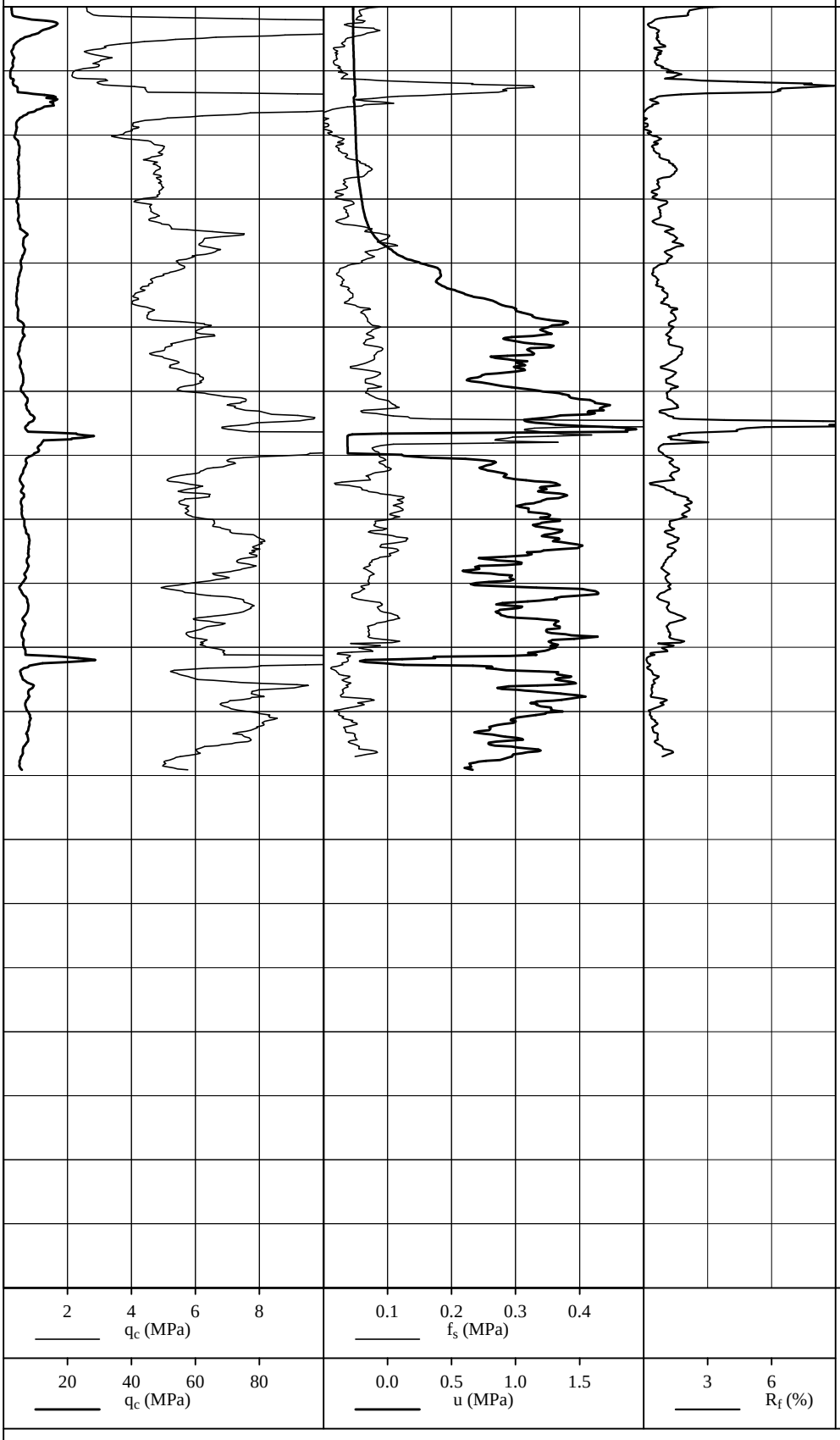
CPT name : ST14461-CPT36



E	: 393370,3	Cone no.	: 130707	Rig	: GEOScope
N	: 5899741,7	Cone type	: TSP	Performed by	: JPM/2014-03-18 03:47:52
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Depth

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Prepared	: JPM	Date: 2014-03-18	Subject: ST14461-CPT36		
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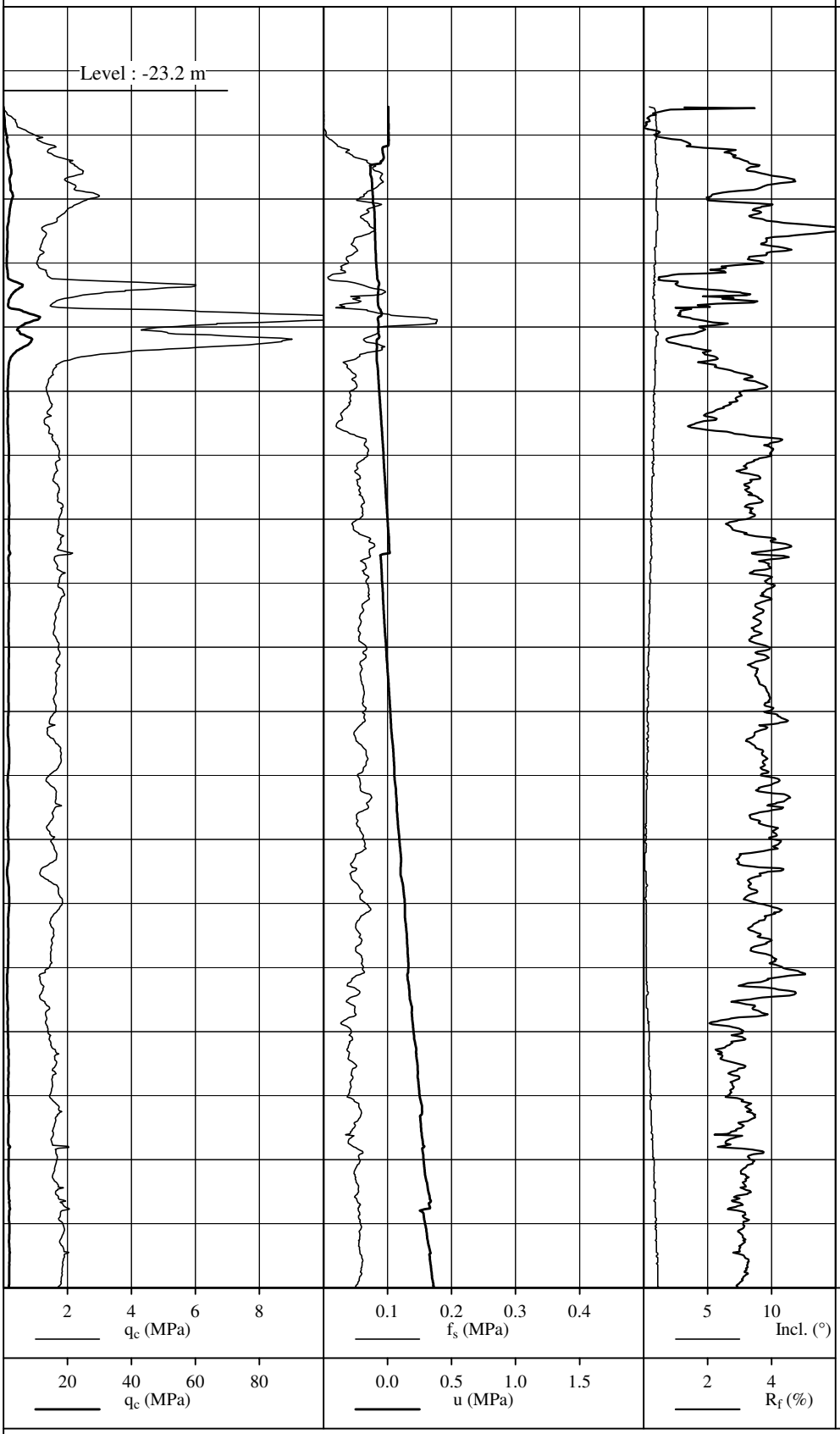
CPT name : ST14461-CPT4



E	: 393037.7	Cone no.	: 130811	Rig	: GEOScope
N	: 5898595.9	Cone type	: TSP	Performed by	: JPM/2014-03-13
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT4		
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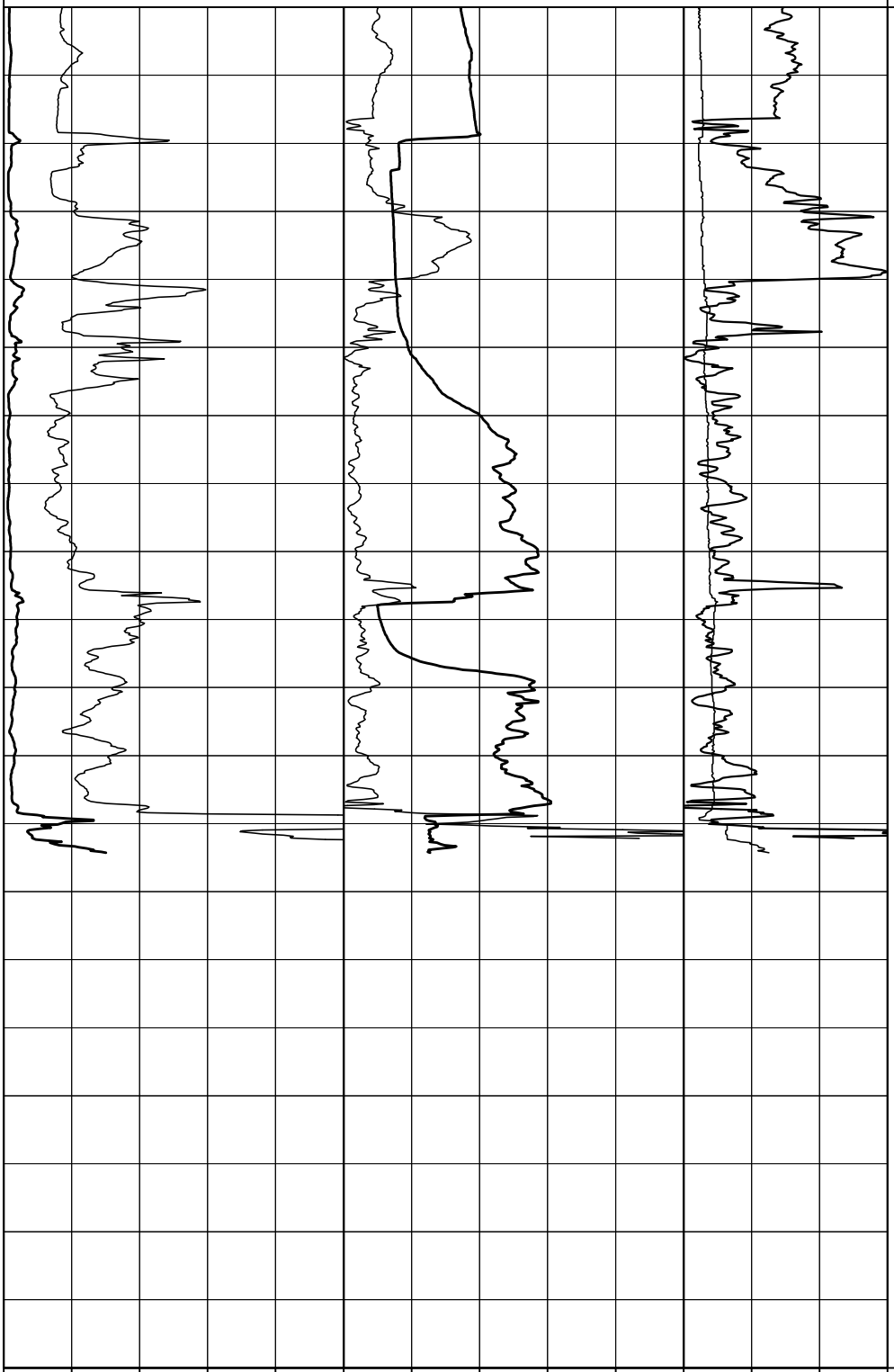
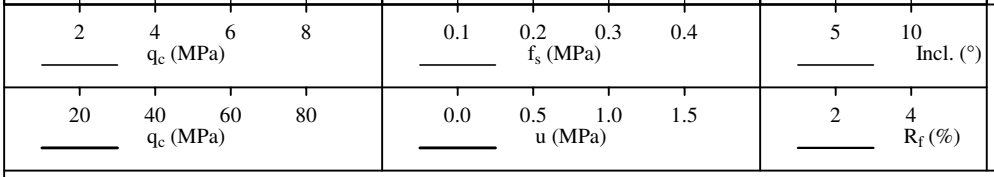
CPT name : ST14461-CPT4





E	: 393037.7	Cone no.	: 130811	Rig	: GEOScope
N	: 5898595.9	Cone type	: TSP	Performed by	: JPM/2014-03-13
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT4		
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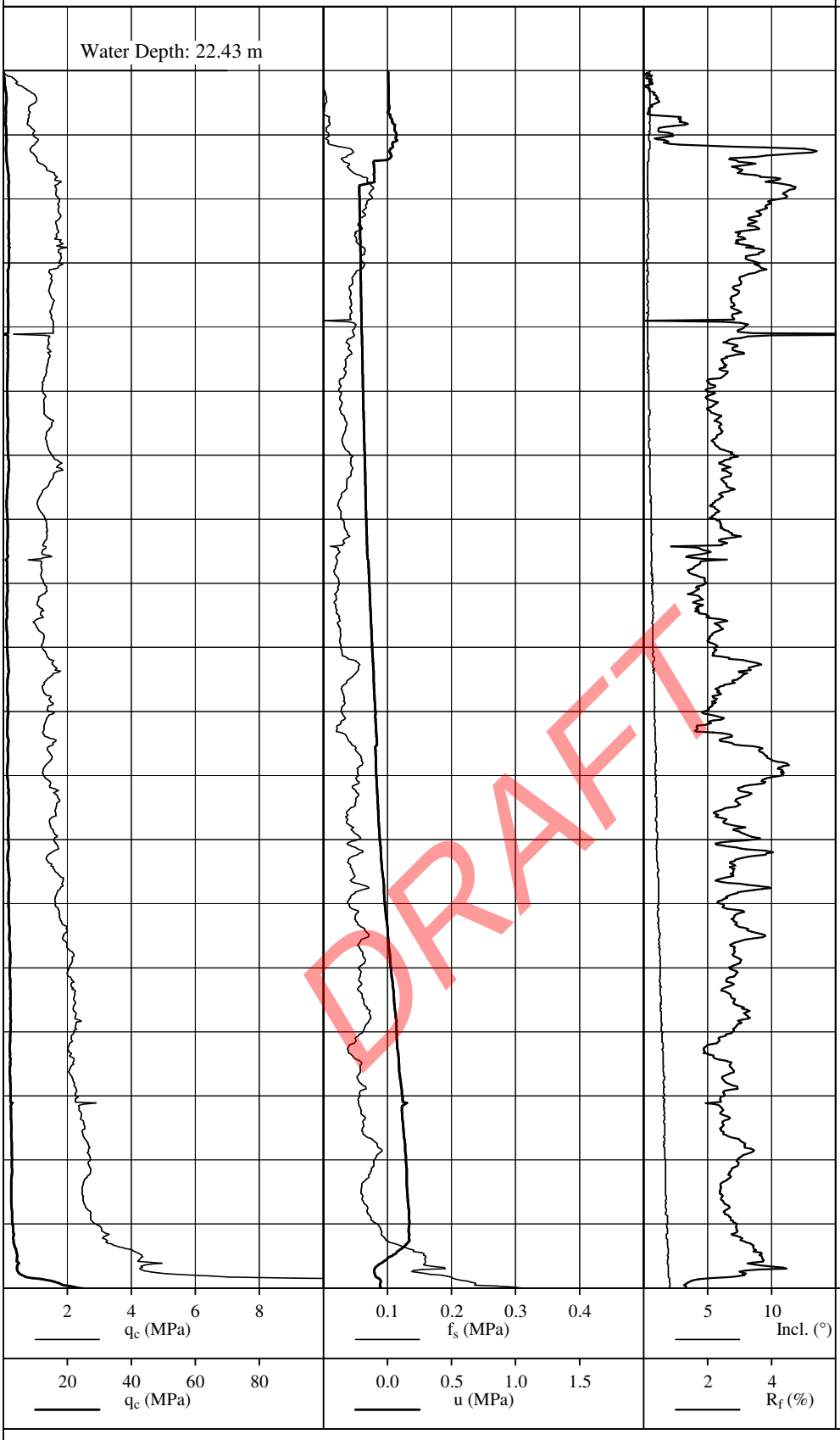
CPT name : ST14461-CPT41



E	: 389708.2	Cone no.	: 130711	Rig	: GEOScope
N	: 5902710.8	Cone type	: TSP	Performed by	: LEJ/2014-03-23
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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Prepared	: LEJ	Date: 2014-03-23	Subject: ST14461-CPT41		
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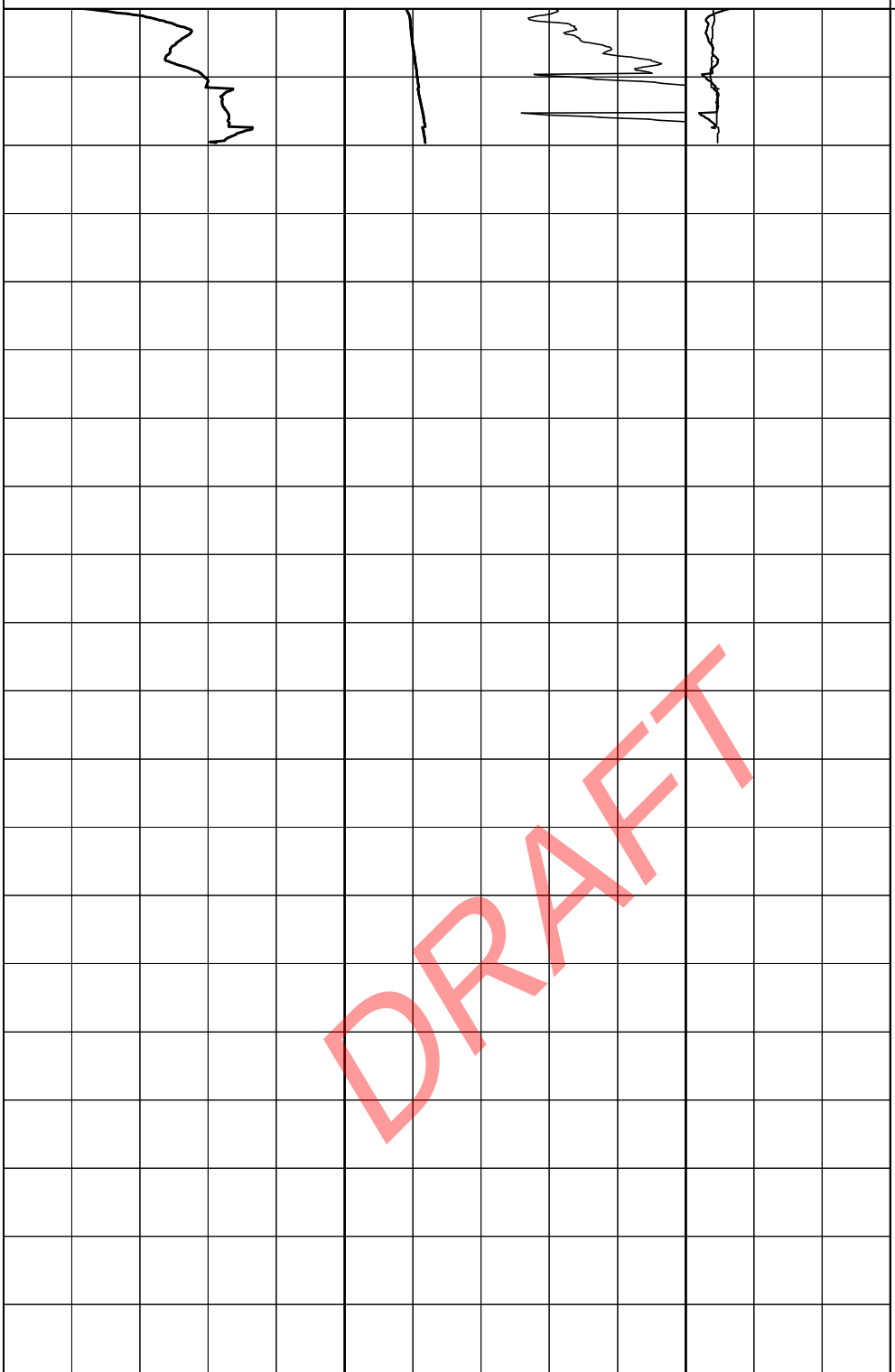
CPT name : ST14461-CPT41



2 4 6 8
q_c (MPa)

20 40 60 80
q_c (MPa)

0.1 0.2 0.3 0.4
f_s (MPa)

0.0 0.5 1.0 1.5
u (MPa)

5 10
Incl. (°)

2 4
R_f (%)

Depth (m)

E	: 389708.2	Cone no.	: 130711	Rig	: GEOScope
N	: 5902710.8	Cone type	: TSP	Performed by	: LEJ/2014-03-23
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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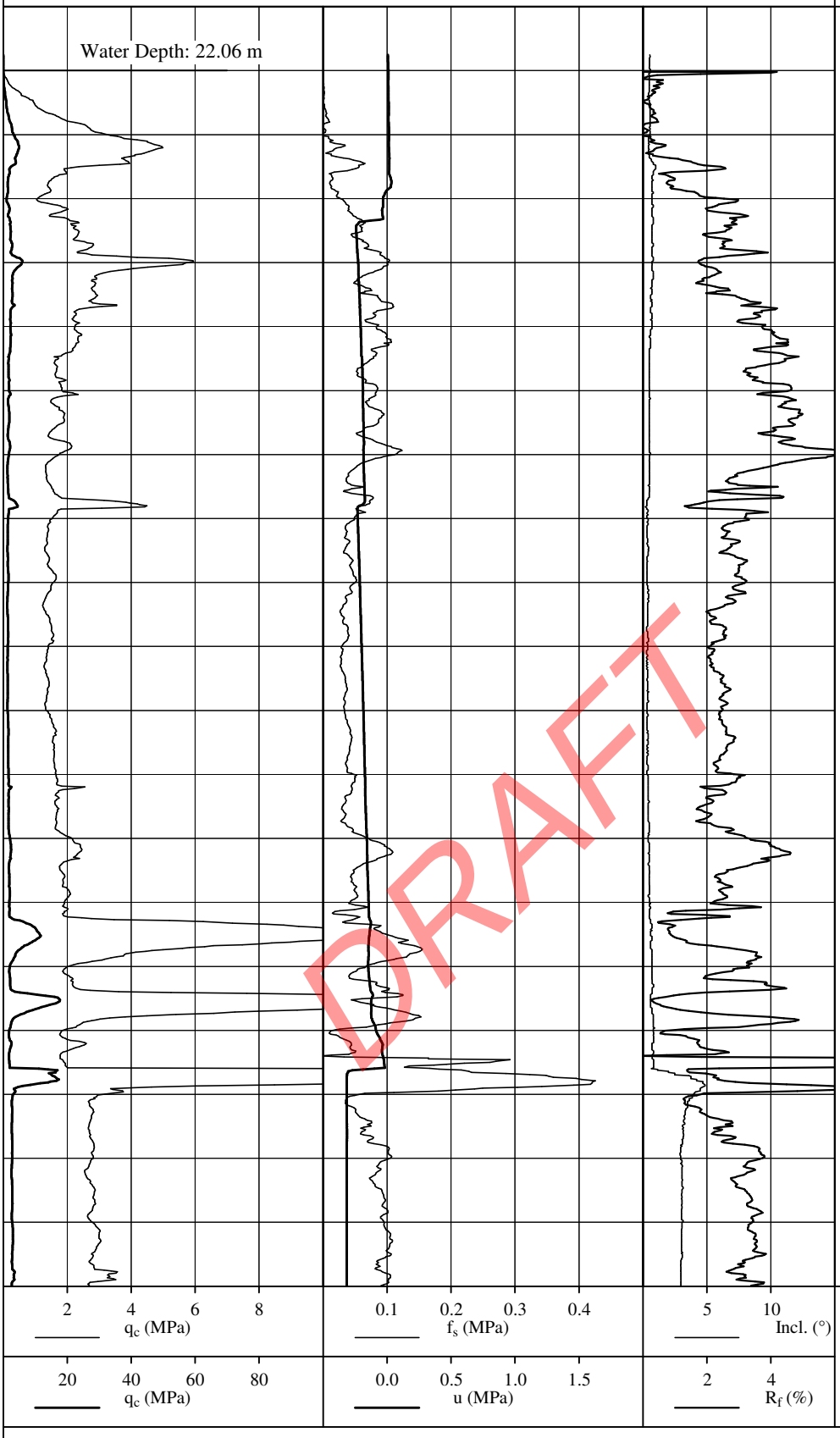
CPT name : ST14461-CPT42



E	: 388974.5	Cone no.	: 130711	Rig	: GEOScope
N	: 5903306.1	Cone type	: TSP	Performed by	: LEJ/2014-03-23
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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Prepared	: LEJ	Date: 2014-03-23	Subject: ST14461-CPT42	
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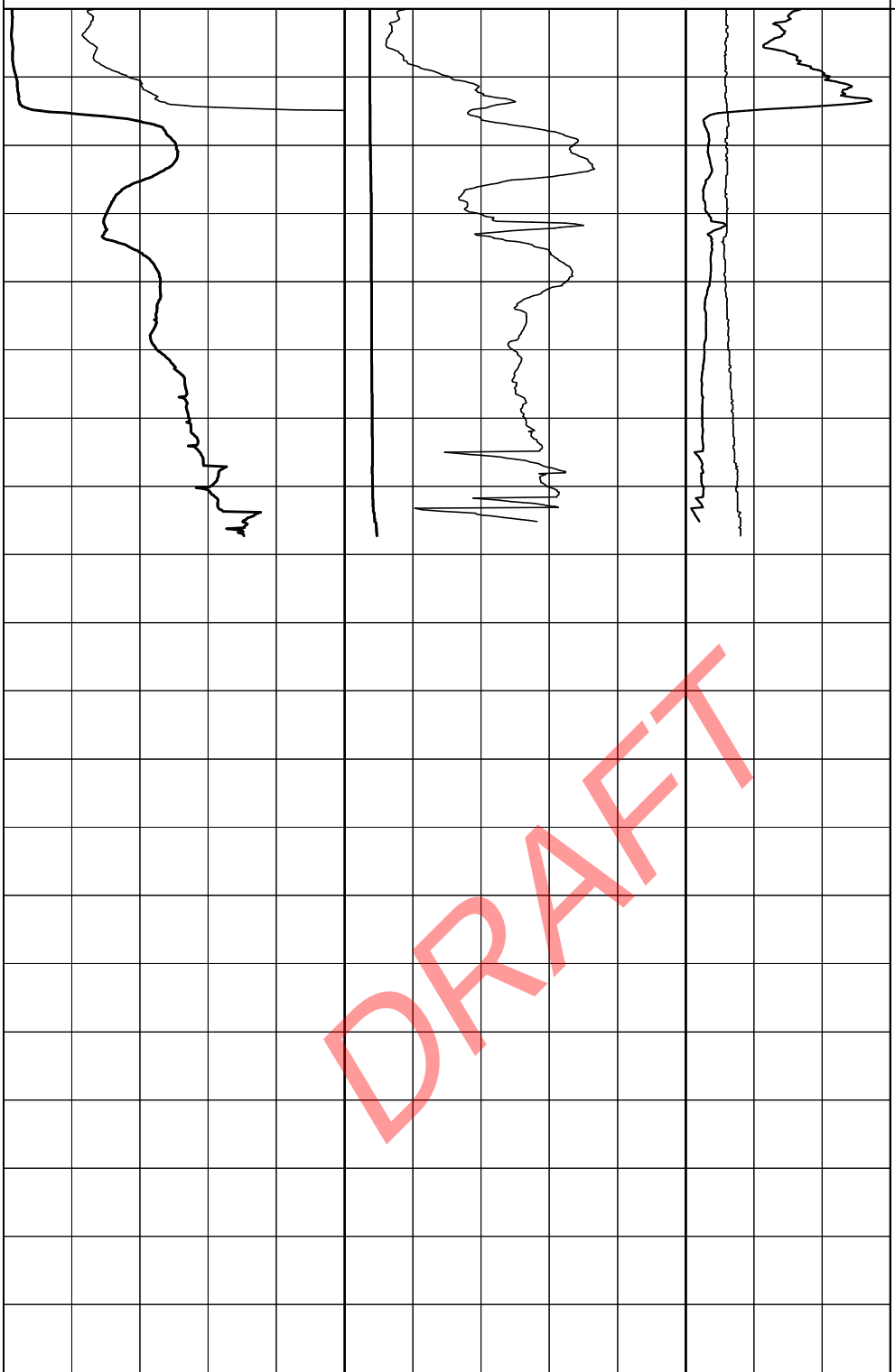
CPT name : ST14461-CPT42



2 4 6 8
q_c (MPa)

20 40 60 80
q_c (MPa)

0.1 0.2 0.3 0.4
f_s (MPa)

0.0 0.5 1.0 1.5
u (MPa)

5 10
Incl. (°)

2 4
R_f (%)

Depth (m)

E	: 388974.5	Cone no.	: 130711	Rig	: GEOScope
N	: 5903306.1	Cone type	: TSP	Performed by	: LEJ/2014-03-23
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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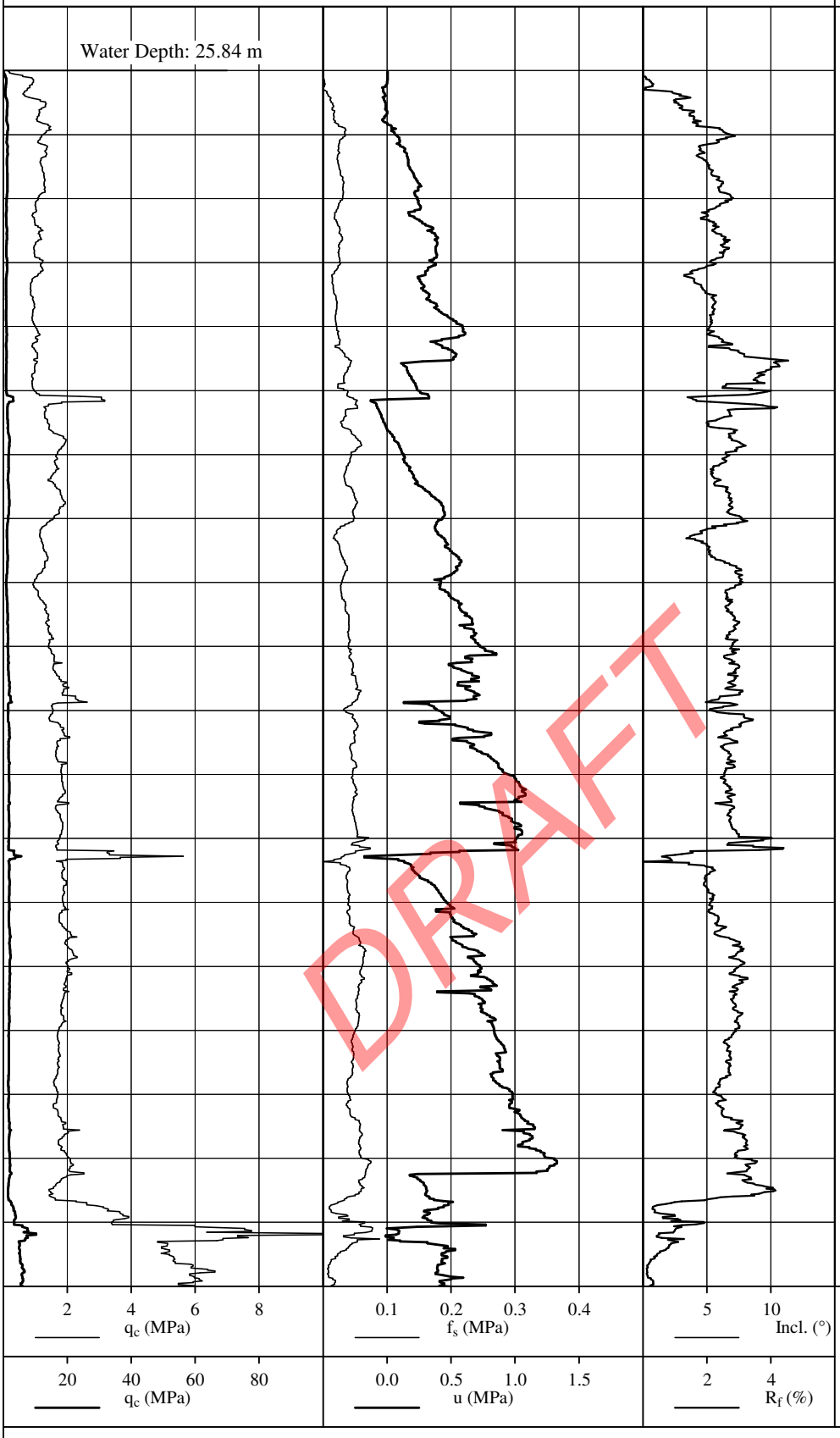
CPT name : ST14461-CPT45



E	: 393499.7	Cone no.	: 100648	Rig	: GEOScope
N	: 5901056.7	Cone type	: TSP	Performed by	: JPM/2014-03-26
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Tip

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Prepared	: JPM	Date: 2014-03-26	Subject: ST14461-CPT45	
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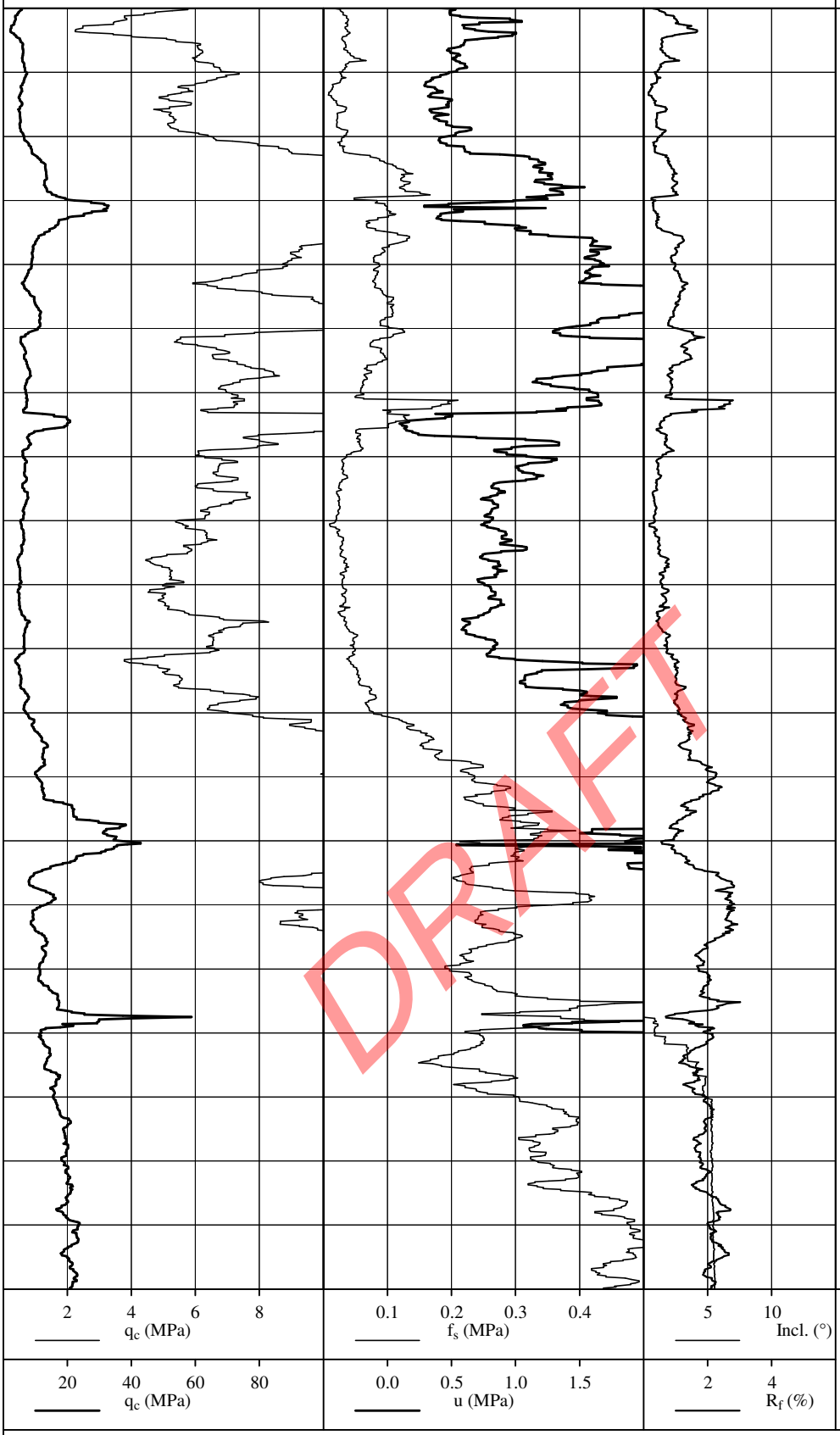
CPT name : ST14461-CPT45



E	: 393499.7	Cone no.	: 100648	Rig	: GEOScope
N	: 5901056.7	Cone type	: TSP	Performed by	: JPM/2014-03-26
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Tip

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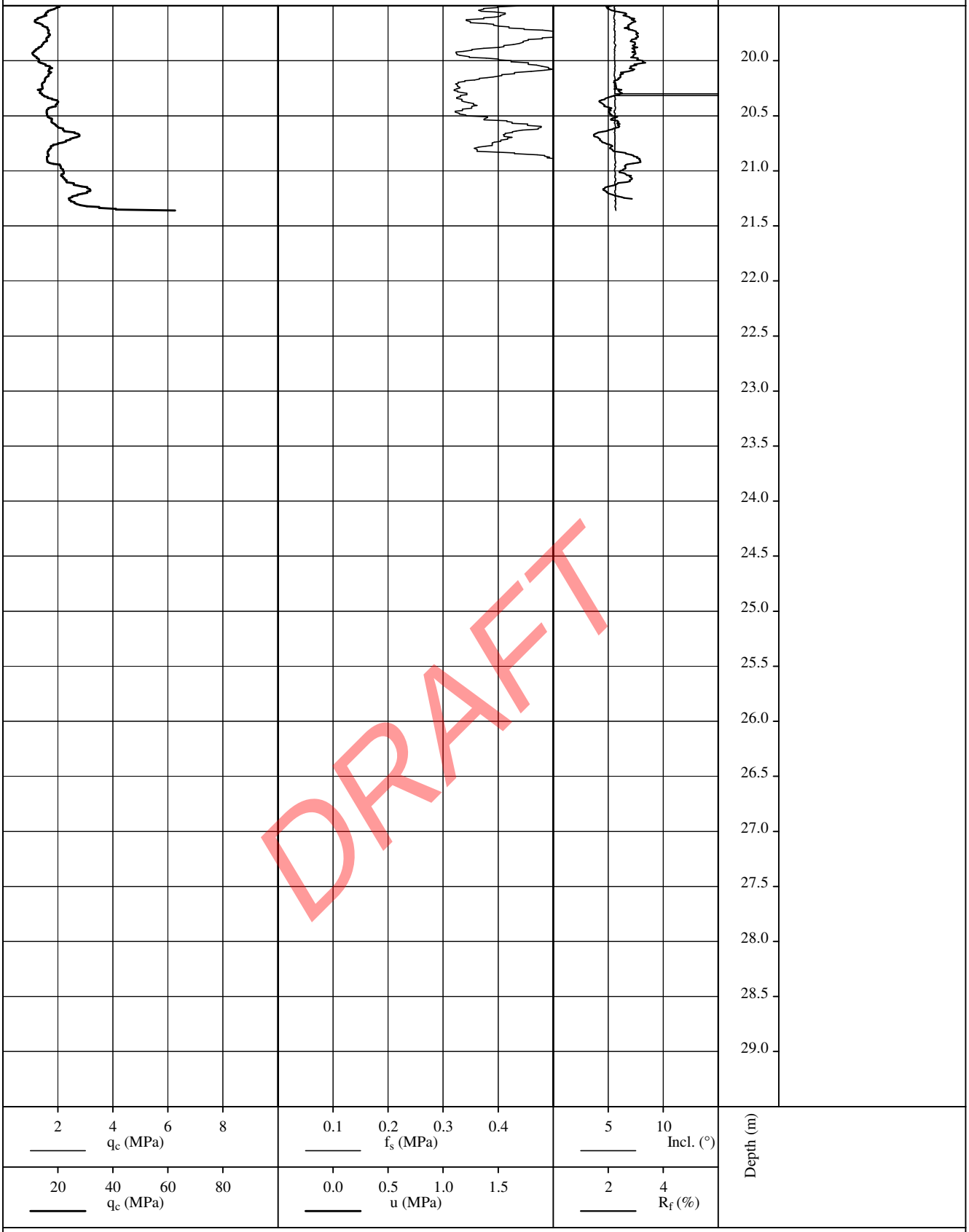
CPT name : ST14461-CPT45



E	: 393499.7	Cone no.	: 100648	Rig	: GEOScope
N	: 5901056.7	Cone type	: TSP	Performed by	: JPM/2014-03-26
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Tip

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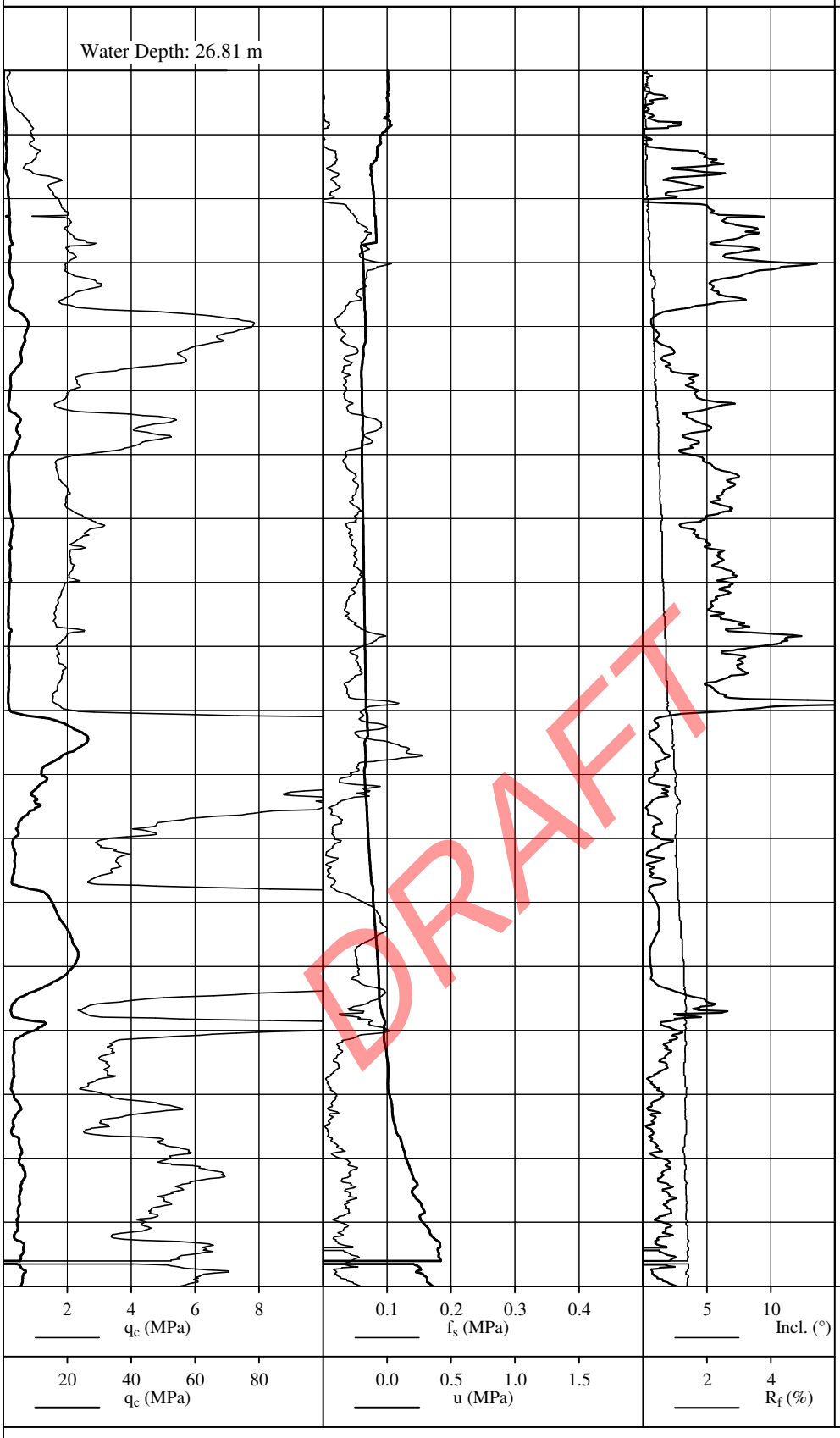
CPT name : ST14461-CPT46



2 4 6 8
q_c (MPa)

0.1 0.2 0.3 0.4
f_s (MPa)

5 10
Incl. (°)

20 40 60 80
q_c (MPa)

0.0 0.5 1.0 1.5
u (MPa)

2 4
R_f (%)

Depth (m)

E	: 392776,8	Cone no.	: 130706	Rig	: GEOScope
N	: 5901653,0	Cone type	: TSP	Performed by	: BVI/2014-03-22
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max depth

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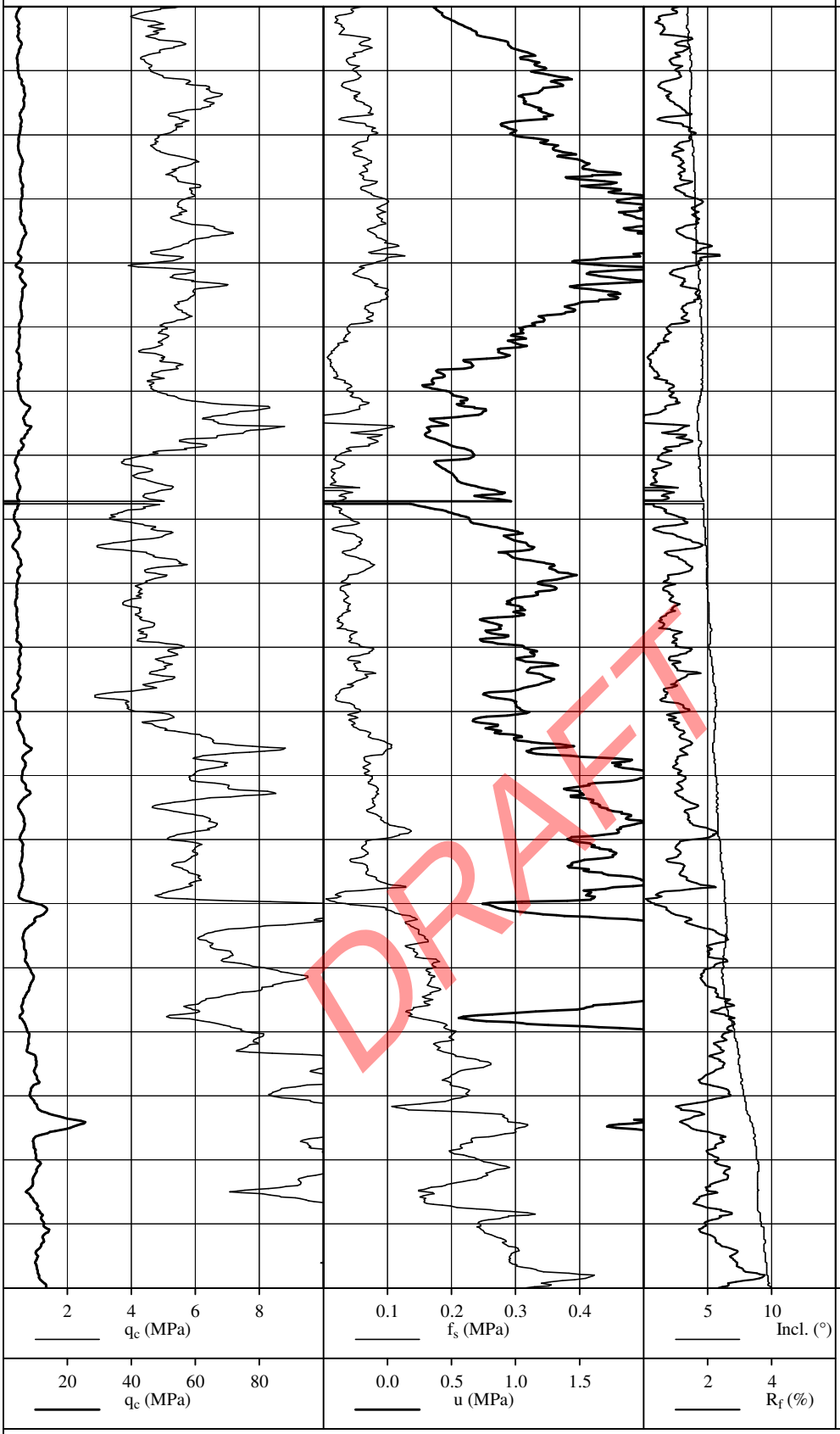
Printed 2014-03-22 12:06:22

CPT name : ST14461-CPT46



E	: 392776,8	Cone no.	: 130706	Rig	: GEOScope
N	: 5901653,0	Cone type	: TSP	Performed by	: BVI/2014-03-22
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max depth

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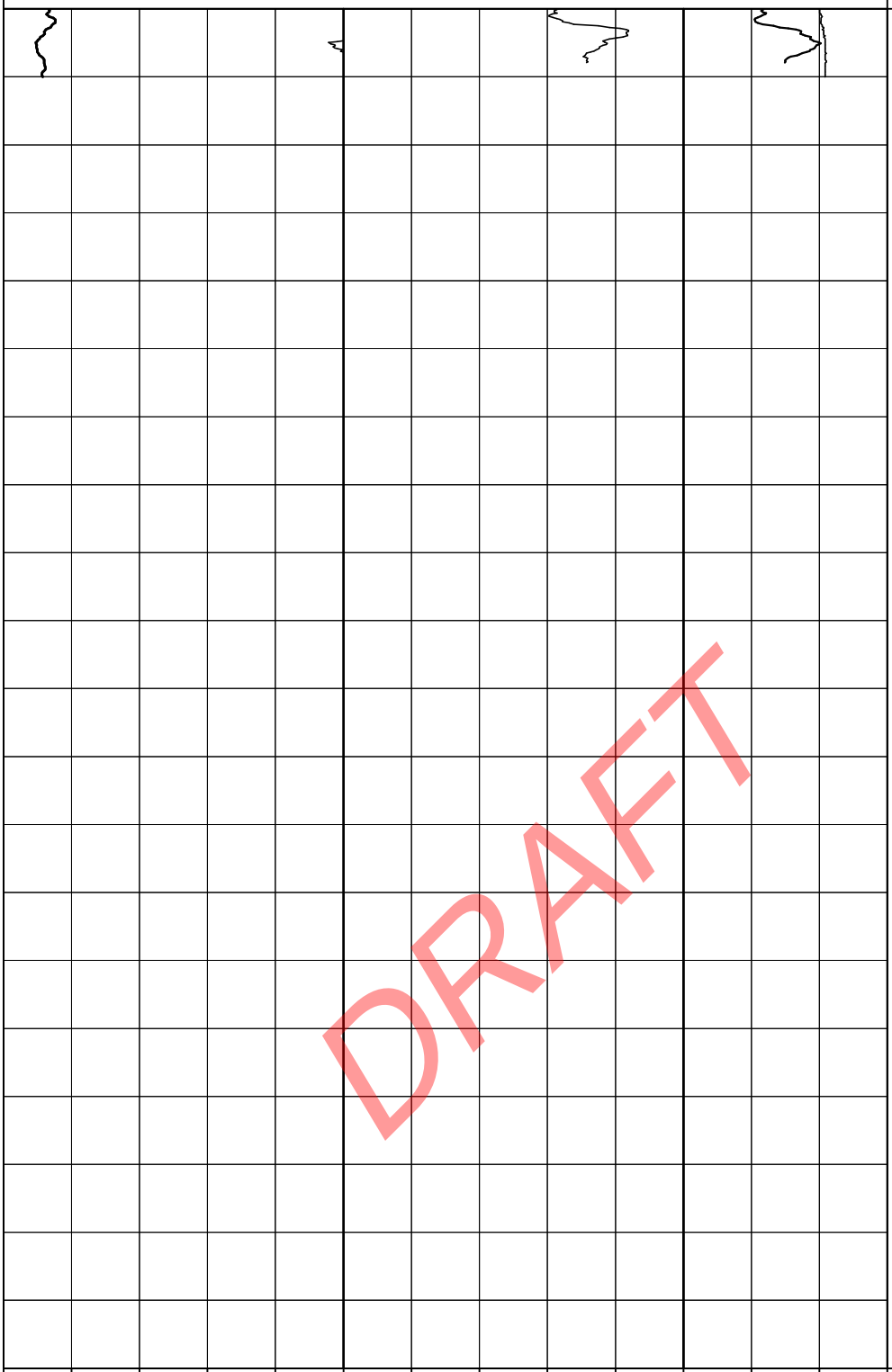
Printed 2014-03-22 12:06:23

CPT name : ST14461-CPT46



2 4 6 8 — q_c (MPa)

20 40 60 80 — q_c (MPa)

0.1 0.2 0.3 0.4 — f_s (MPa)

0.0 0.5 1.0 1.5 — u (MPa)

5 10 — Incl. (°)

2 4 — R_f (%)

Depth (m)

E	: 392776,8	Cone no.	: 130706	Rig	: GEOScope
N	: 5901653,0	Cone type	: TSP	Performed by	: BVI/2014-03-22
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max depth

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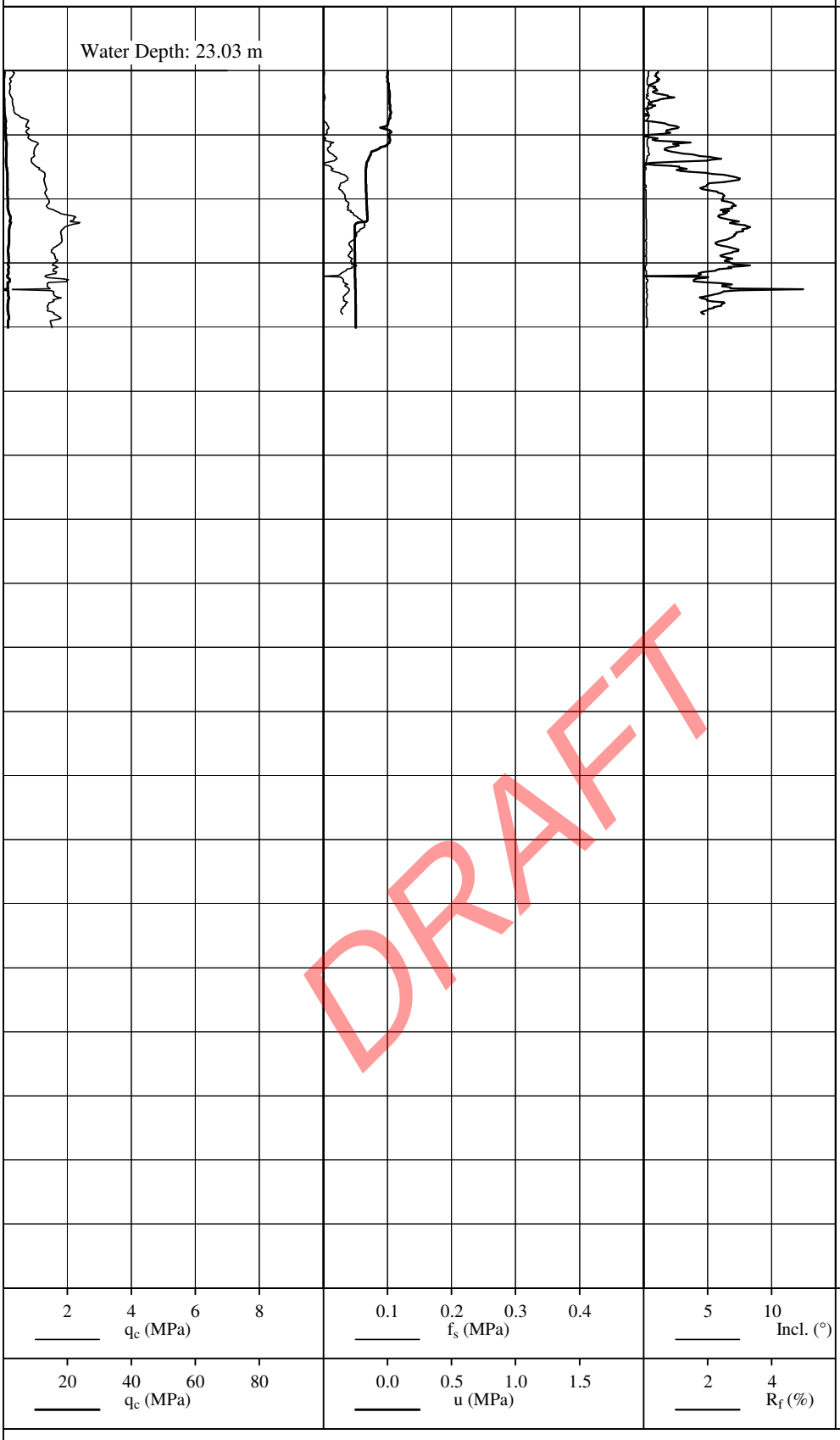
CPT name : ST14461-CPT48



E	: 391313,51	Cone no.	: 130706	Rig	: GEOScope
N	: 5902840,4	Cone type	: TSP	Performed by	: JPM/2014-03-23
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: WOW

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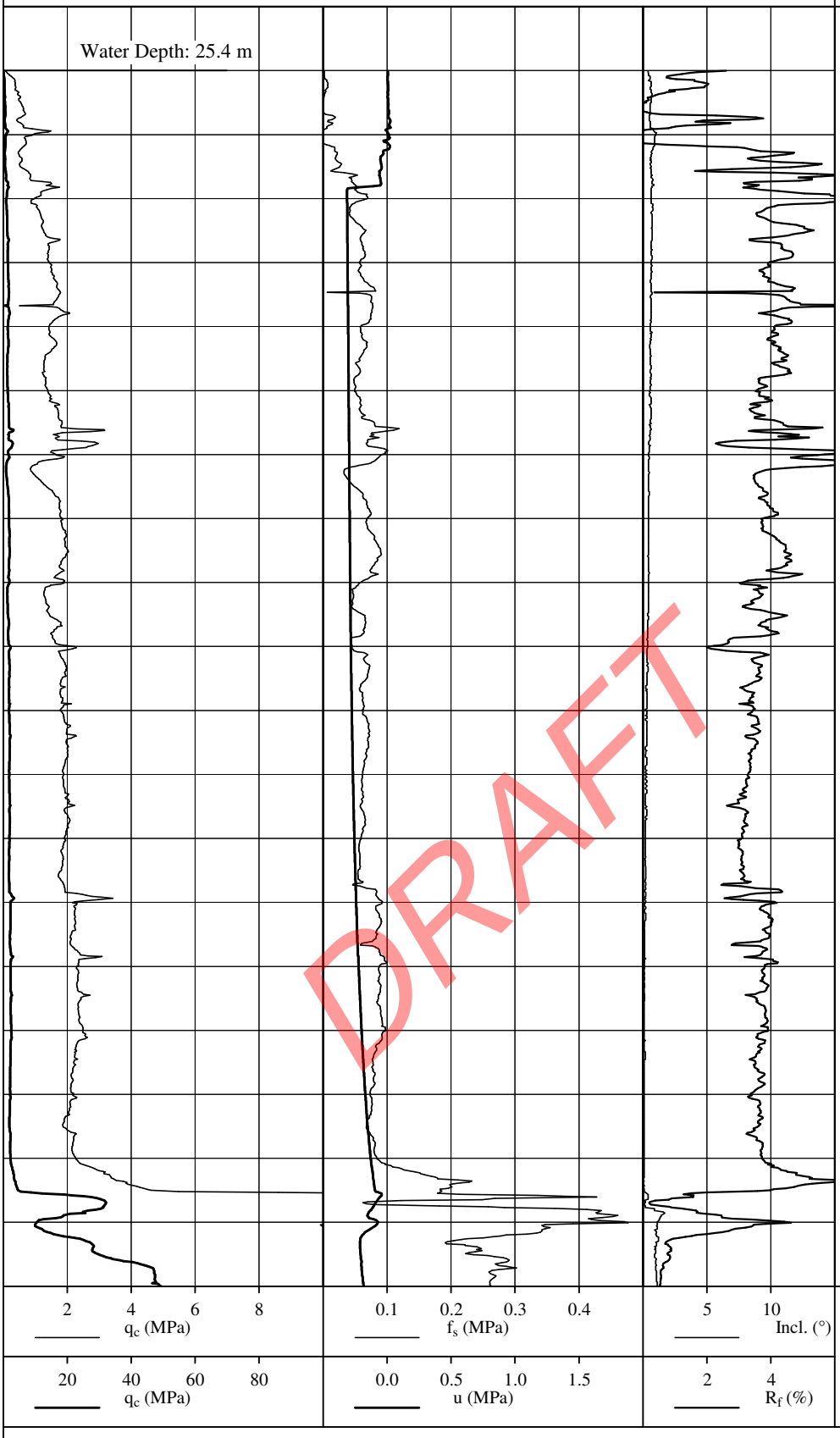
CPT name : ST14461-CPT48a



E	: 391315,9	Cone no.	: 130711	Rig	: GEOScope
N	: 5902845,1	Cone type	: TSP	Performed by	: BVI/2014-03-23 11:34:01
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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Prepared	: BVI	Date: 2014-03-23	Subject: ST14461-CPT48a	
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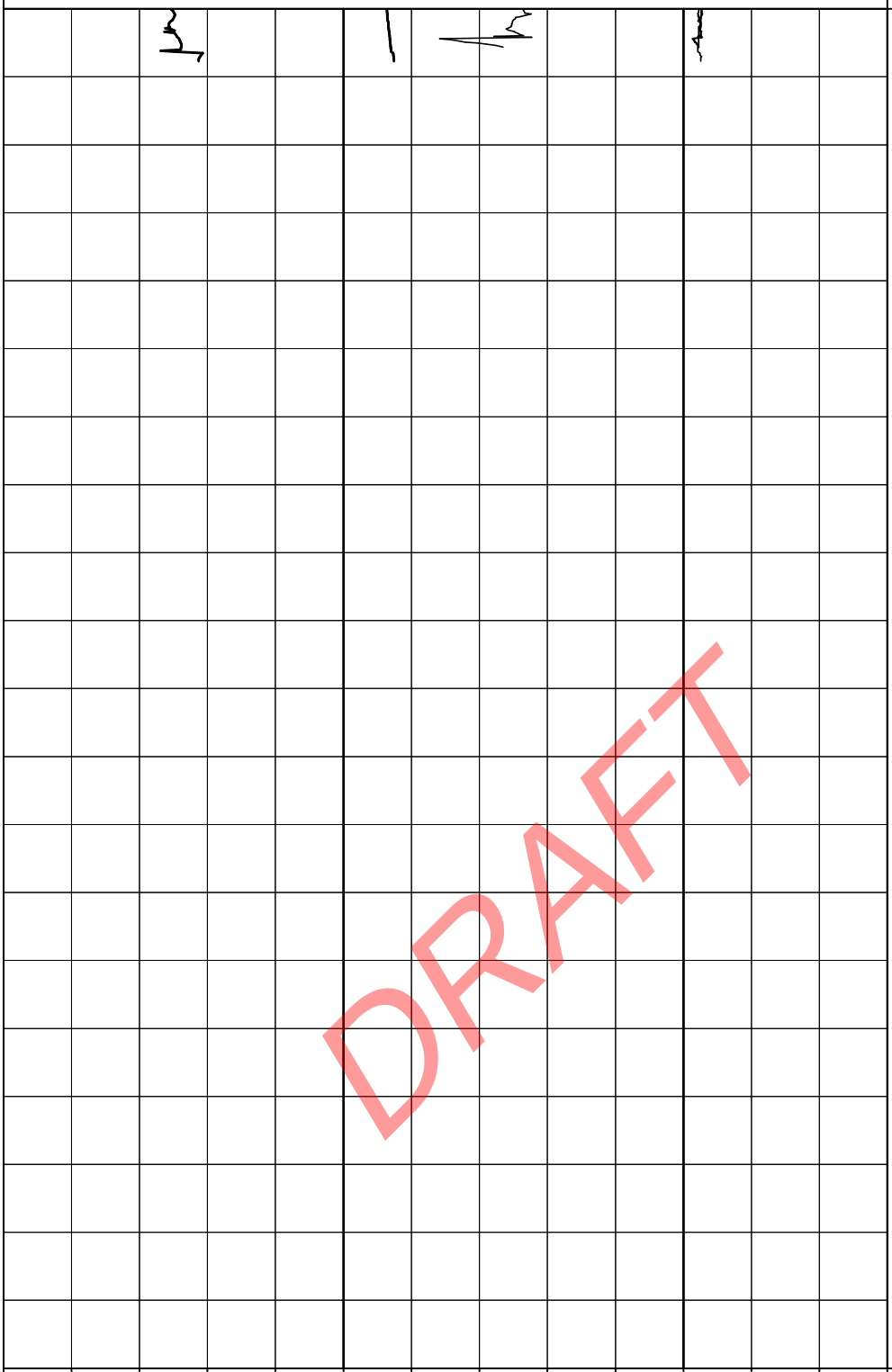
CPT name : ST14461-CPT48a



2 4 6 8	0.1 0.2 0.3 0.4	5 10	Depth (m)
q_c (MPa)	f_s (MPa)	Incl. (°)	
20 40 60 80	0.0 0.5 1.0 1.5	2 4	
q_c (MPa)	u (MPa)	R_f (%)	

E	: 391315,9	Cone no.	: 130711	Rig	: GEOScope
N	: 5902845,1	Cone type	: TSP	Performed by	: BVI/2014-03-23 11:34:01
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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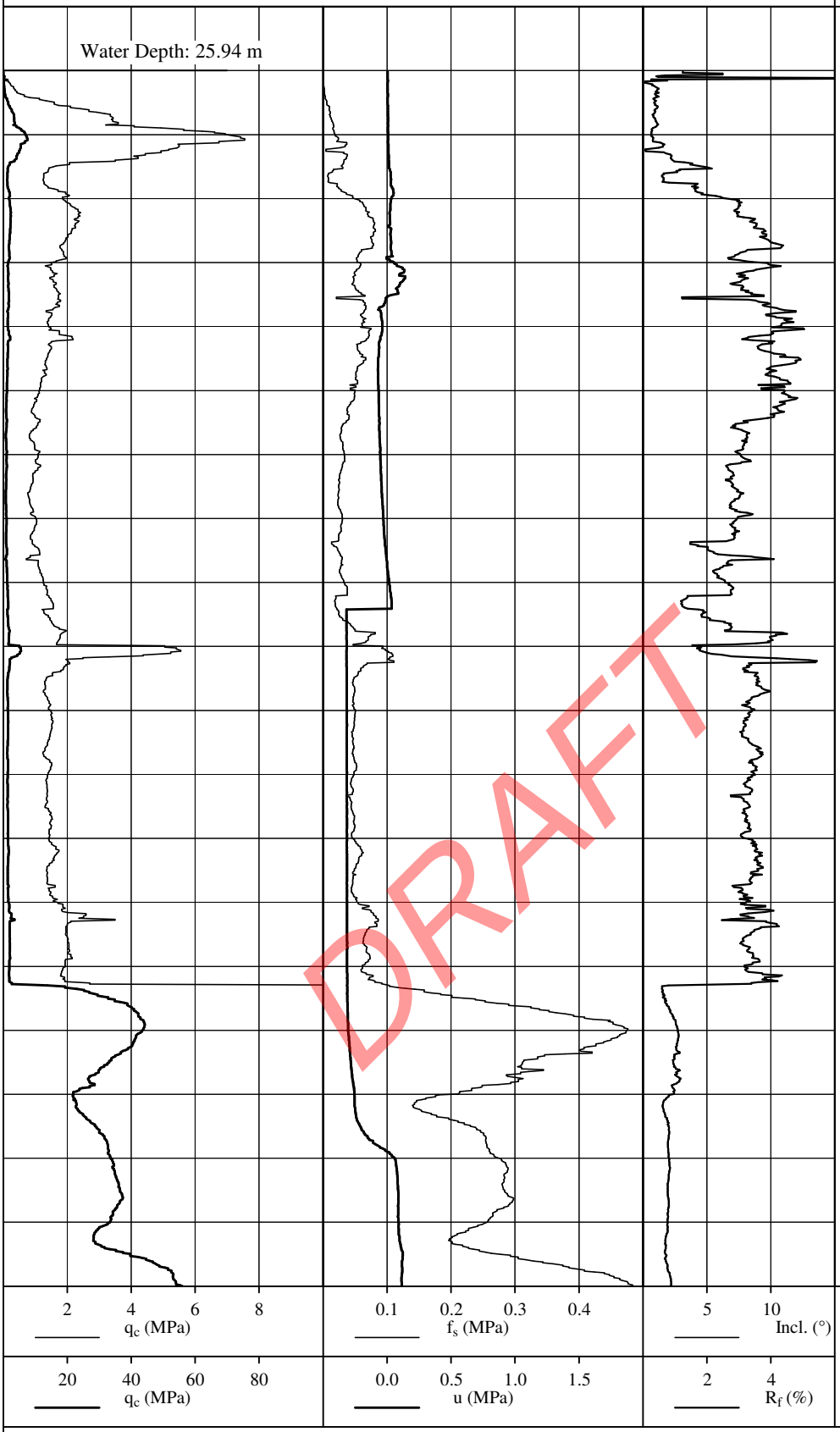
CPT name : ST14461-CPT52



E	: 395205.8	Cone no.	: 100648	Rig	: GEOScope
N	: 5901200.3	Cone type	: TSP	Performed by	: JPM/2014-03-26
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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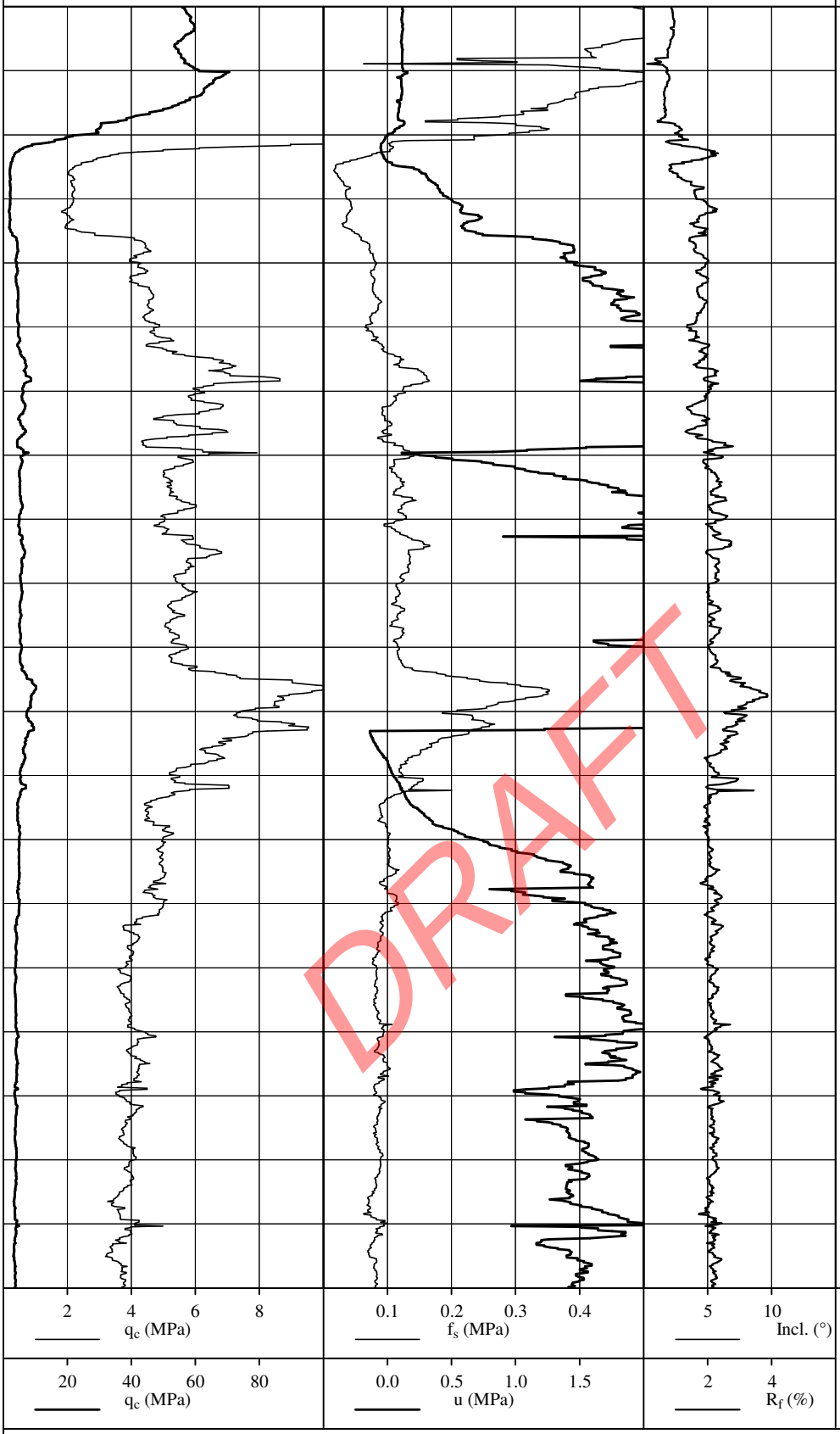
CPT name : ST14461-CPT52



2 4 6 8
q_c (MPa)

20 40 60 80
q_c (MPa)

0.1 0.2 0.3 0.4
f_s (MPa)

0.0 0.5 1.0 1.5
u (MPa)

5 10
Incl. (°)

2 4
R_f (%)

Depth (m)

E	: 395205.8	Cone no.	: 100648	Rig	: GEOScope
N	: 5901200.3	Cone type	: TSP	Performed by	: JPM/2014-03-26
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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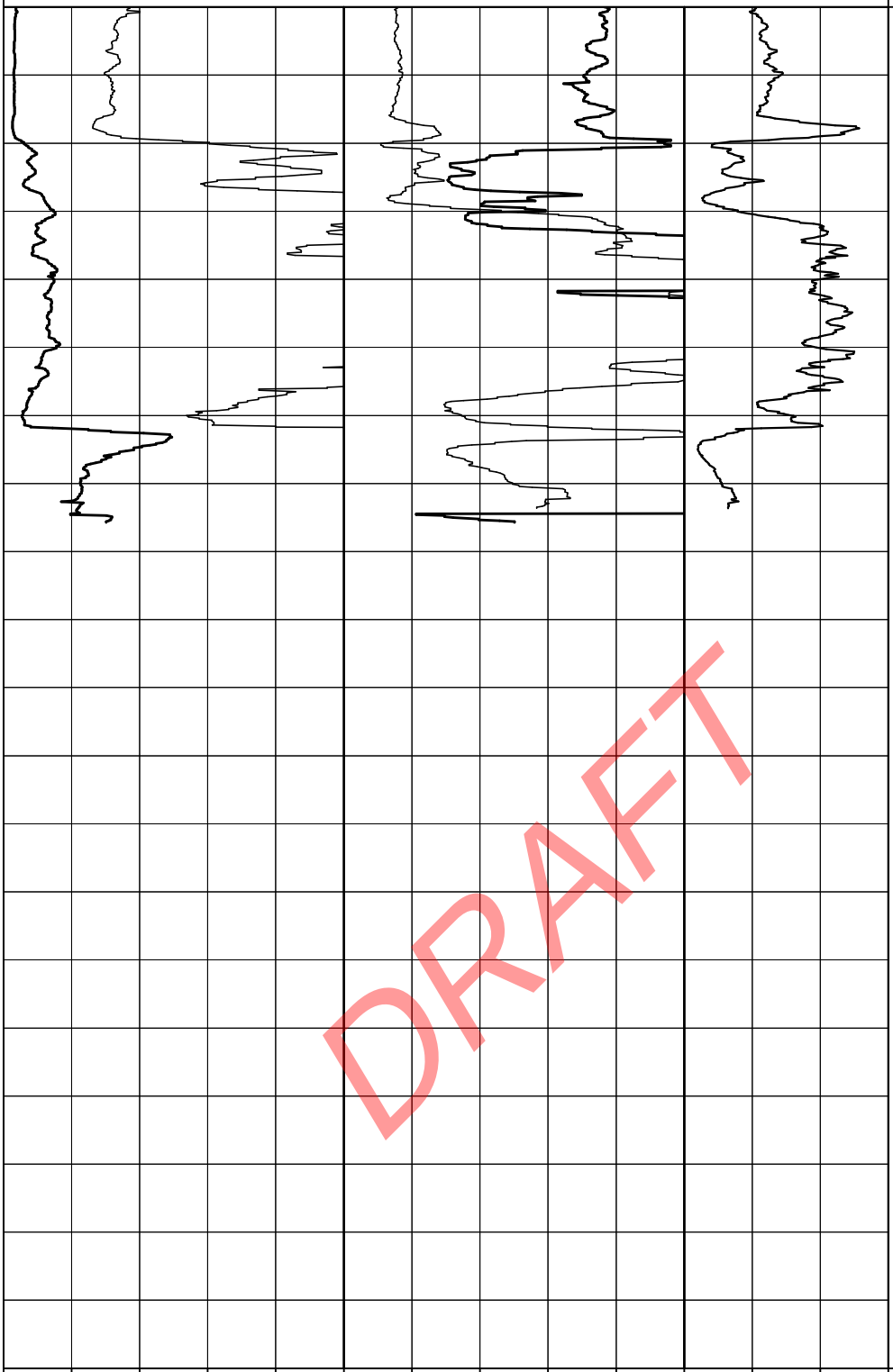

E	: 395205.8	Cone no.	: 100648	Rig	: GEOScope
N	: 5901200.3	Cone type	: TSP	Performed by	: JPM/2014-03-26
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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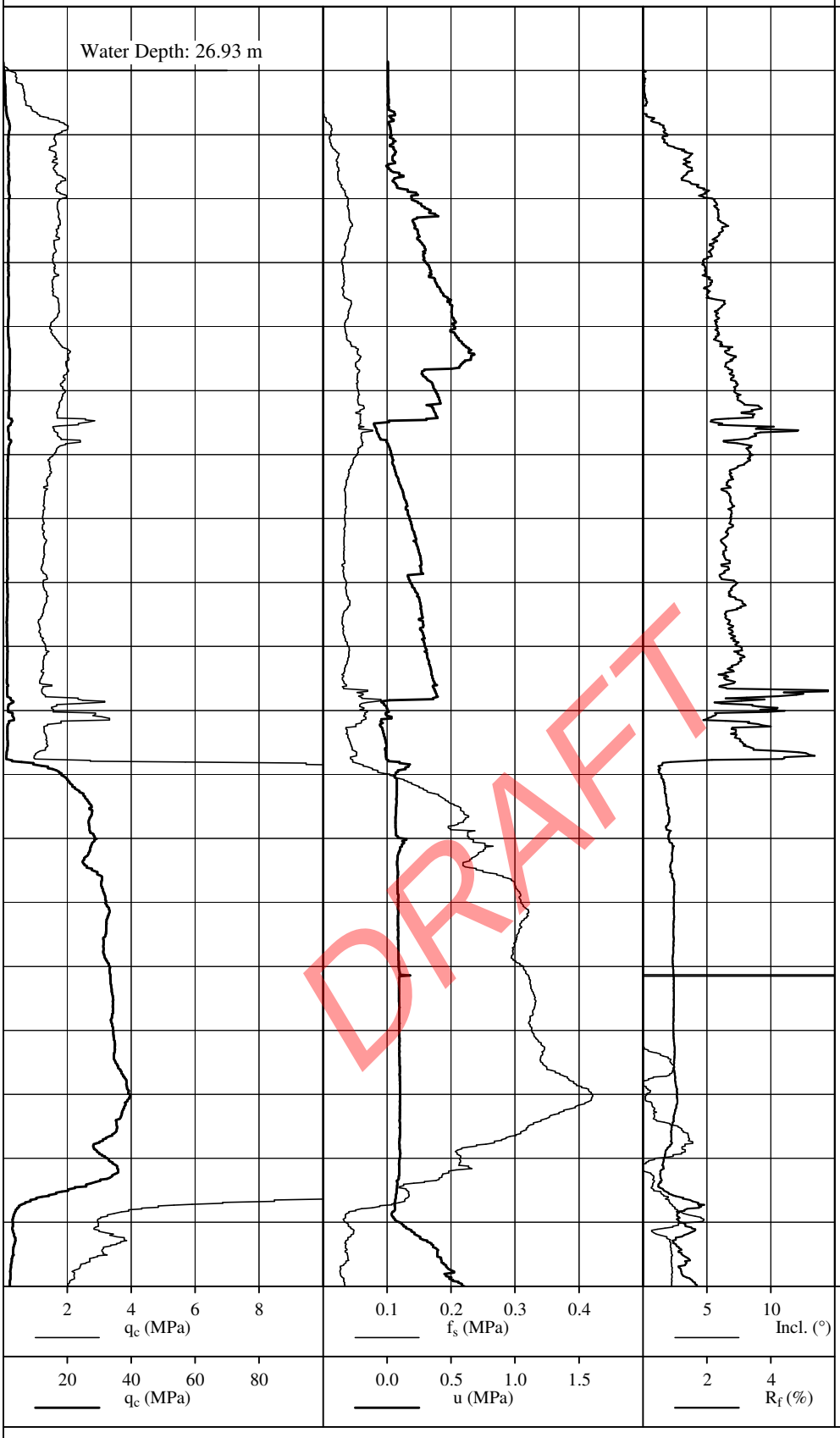
CPT name : ST14461-CPT59



E	: 395286,7	Cone no.	: 100648	Rig	: GEOScope
N	: 5902460,7	Cone type	: TSP	Performed by	: JPM/2014-03-26
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Tip/Sleeve

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Prepared	: JPM	Date: 2014-03-26	Subject: ST14461-CPT59		
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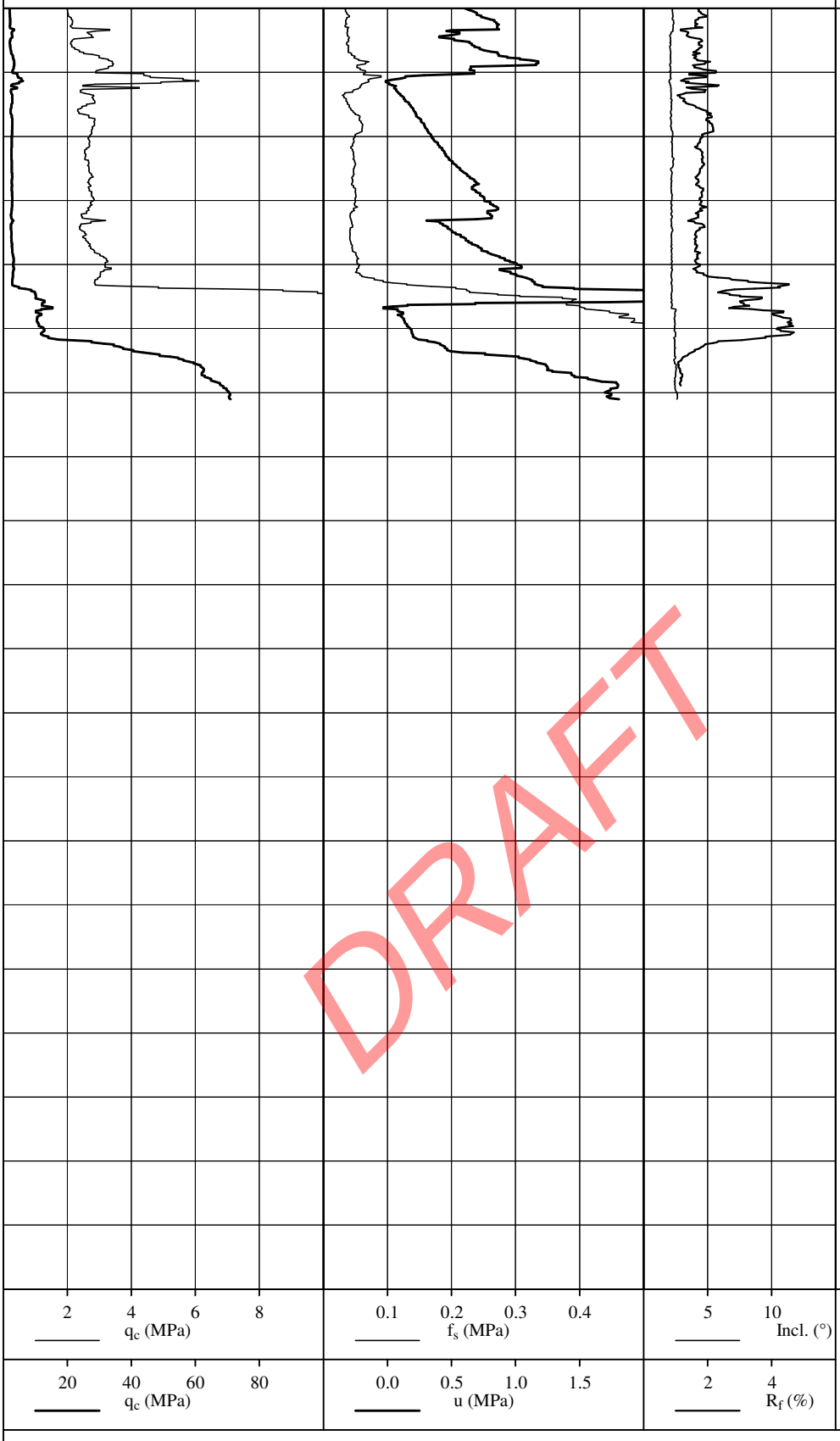
CPT name : ST14461-CPT59



E	: 395286,7	Cone no.	: 100648	Rig	: GEOScope
N	: 5902460,7	Cone type	: TSP	Performed by	: JPM/2014-03-26
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Tip/Sleeve

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Prepared	: JPM	Date: 2014-03-26	Subject: ST14461-CPT59	
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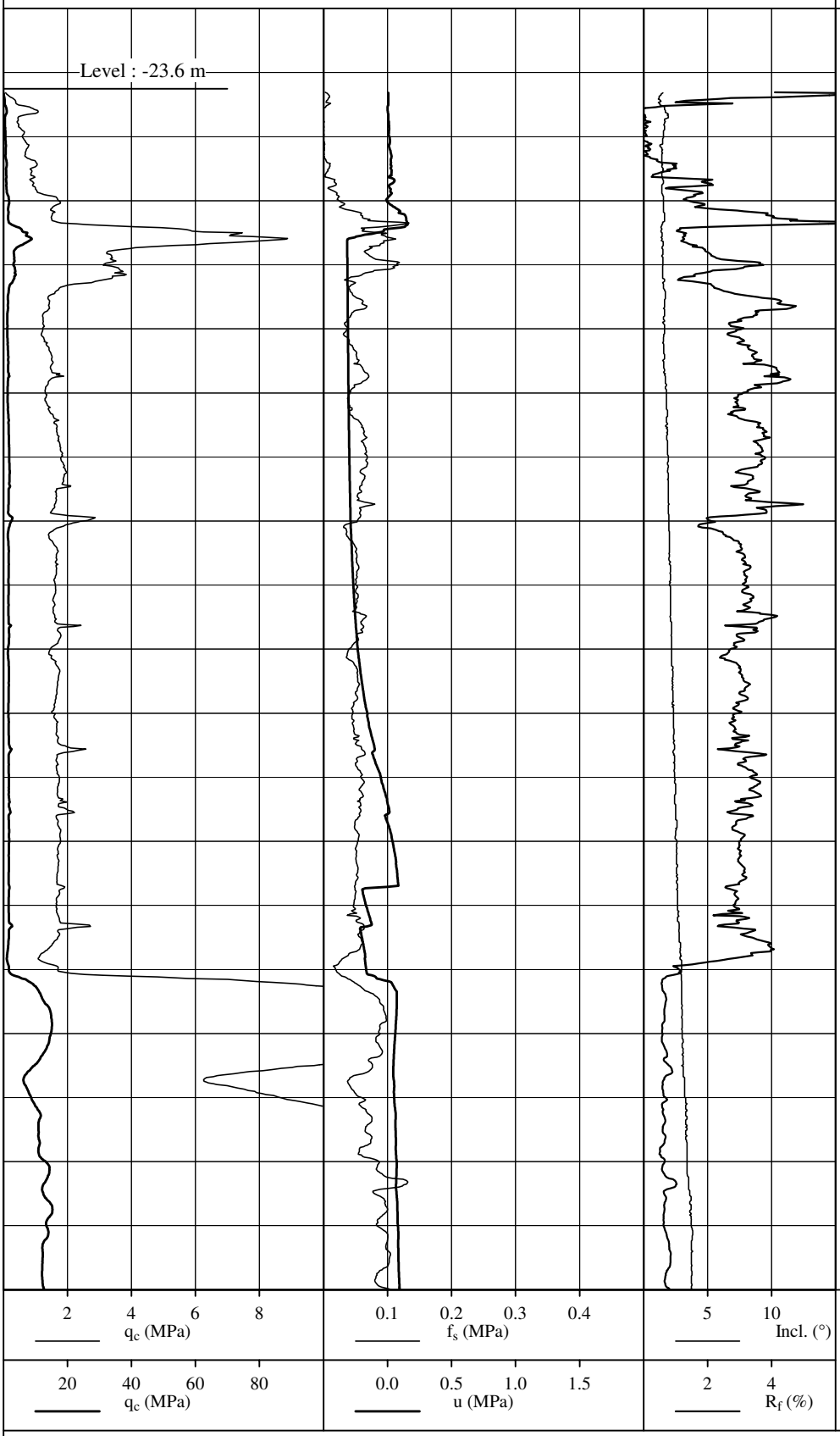
CPT name : ST14461-CPT6



E	: 391760.0	Cone no.	: 130811	Rig	: GEOScope
N	: 5899630.8	Cone type	: TSP	Performed by	: JPM/2014-03-13
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT6		
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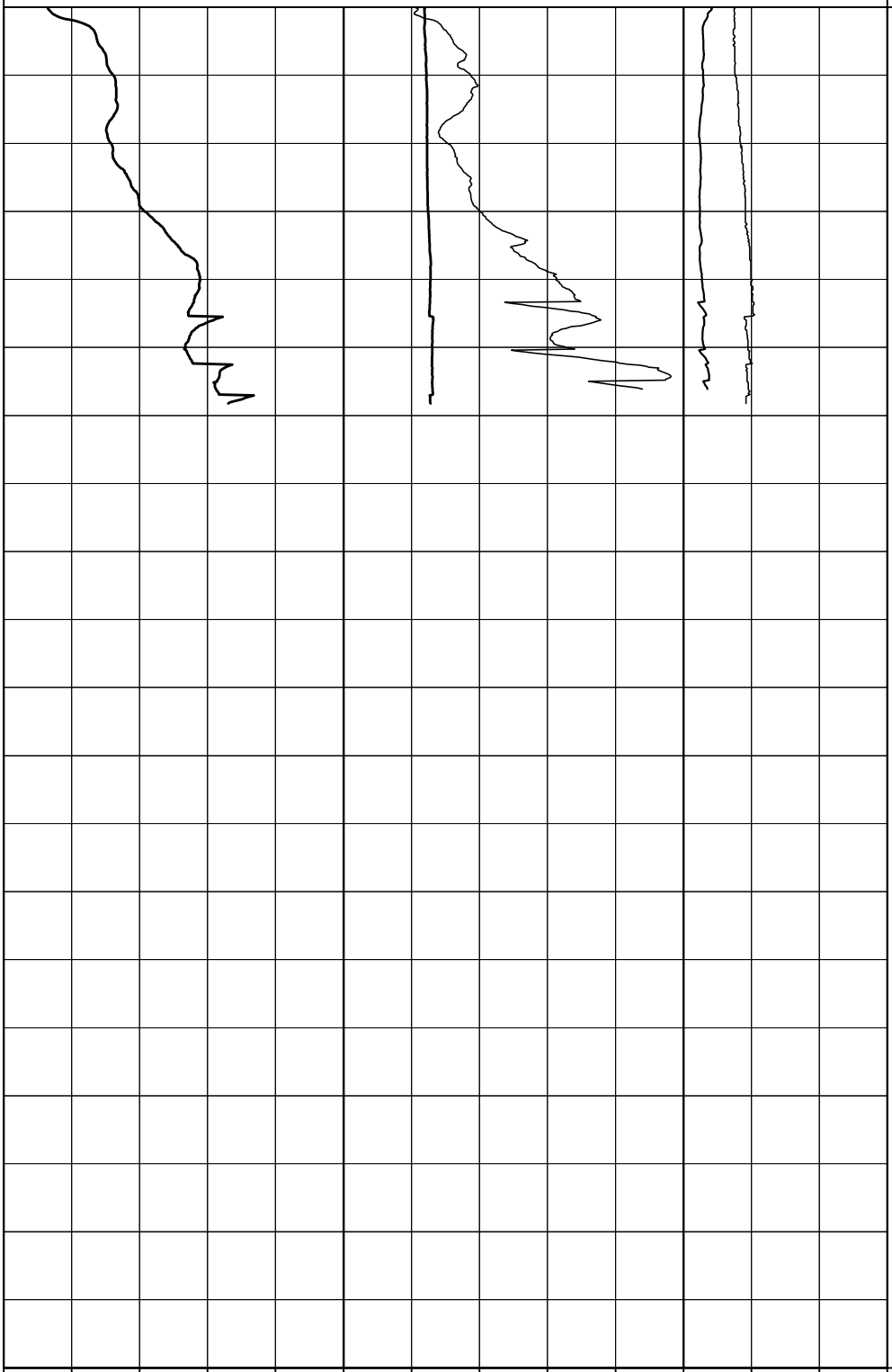
CPT name : ST14461-CPT6



Level (m)	Depth (m)
-33.5	9.5
-34.0	10.0
-34.5	10.5
-35.0	11.0
-35.5	11.5
-36.0	12.0
-36.5	12.5
-37.0	13.0
-37.5	13.5
-38.0	14.0
-38.5	14.5
-39.0	15.0
-39.5	15.5
-40.0	16.0
-40.5	16.5
-41.0	17.0
-41.5	17.5
-42.0	18.0
-42.5	18.5
	19.0

2 4 6 8 q_c (MPa)

20 40 60 80 q_c (MPa)

0.1 0.2 0.3 0.4 f_s (MPa)

0.0 0.5 1.0 1.5 u (MPa)

5 10 Incl. (°)

2 4 R_f (%)

E	: 391760.0	Cone no.	: 130811	Rig	: GEOScope
N	: 5899630.8	Cone type	: TSP	Performed by	: JPM/2014-03-13
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT6		
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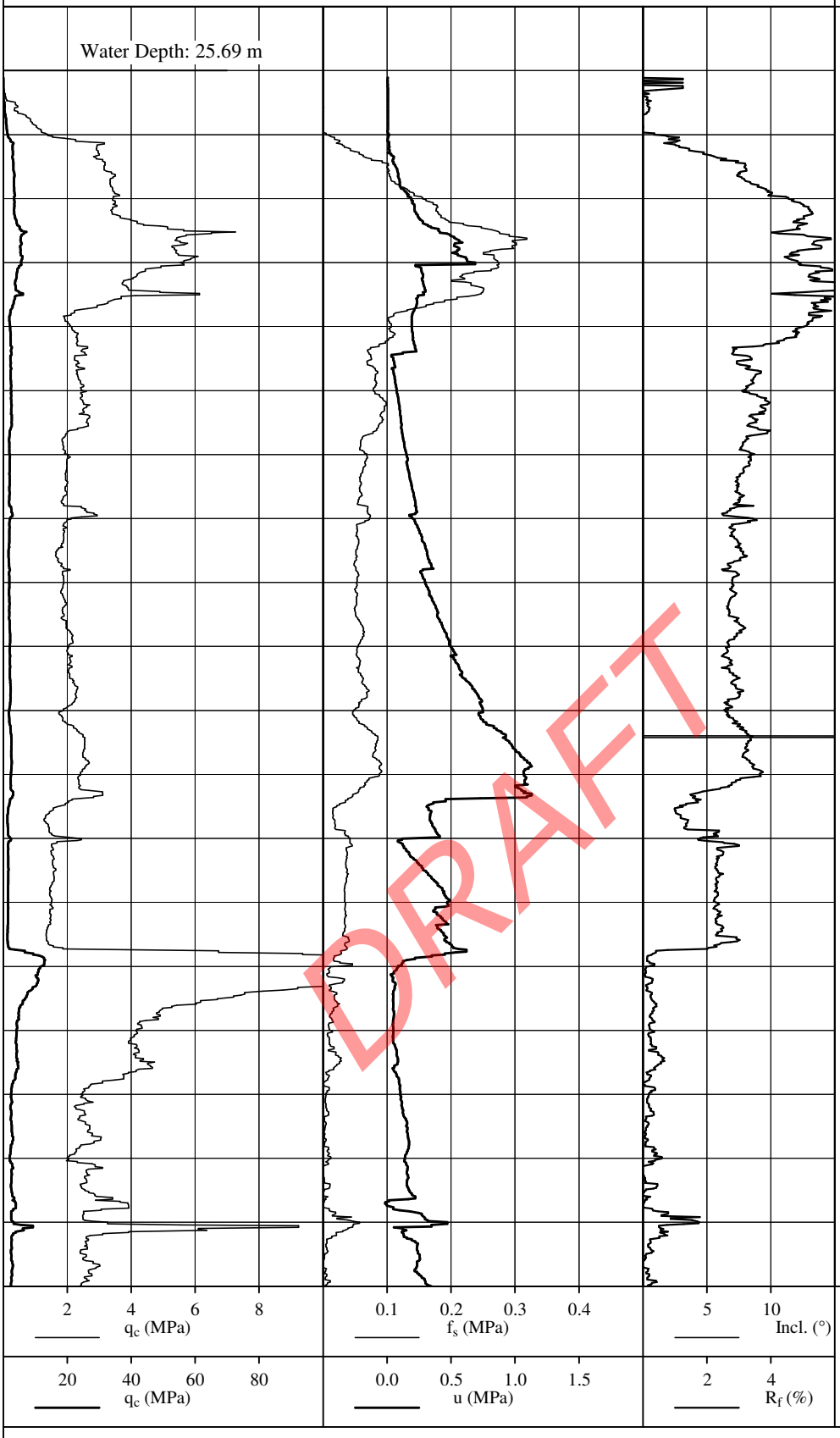
CPT name : ST14461-CPT60



E	: 394553	Cone no.	: 100648	Rig	: GEOScope
N	: 5903055,3	Cone type	: TSP	Performed by	: BVI/2014-03-26
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Sleeve

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Prepared	: BVI	Date: 2014-03-26	Subject: ST14461-CPT60	
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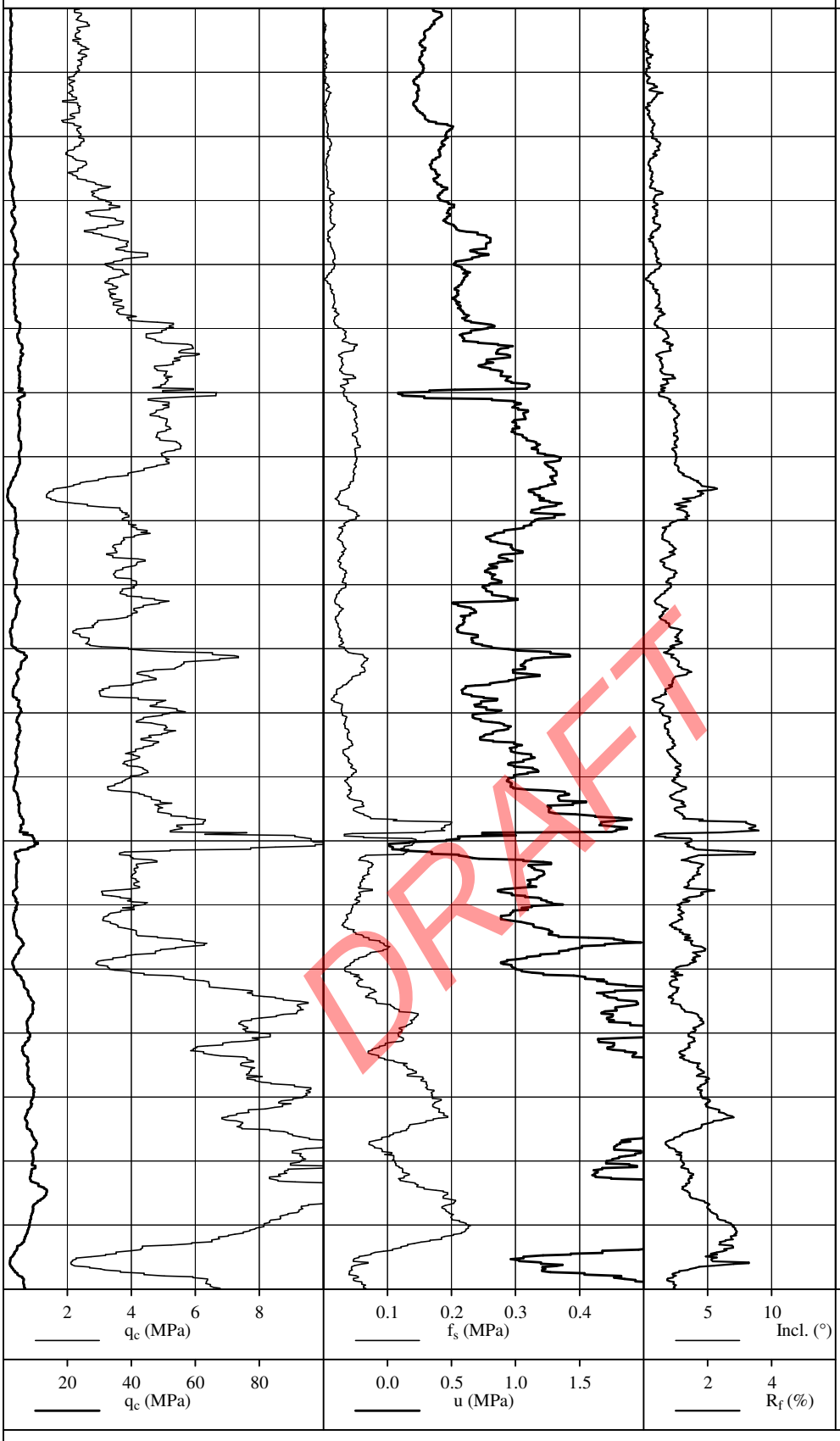
CPT name : ST14461-CPT60



2 4 6 8
q_c (MPa)

20 40 60 80
q_c (MPa)

0.1 0.2 0.3 0.4
f_s (MPa)

0.0 0.5 1.0 1.5
u (MPa)

5 10
Incl. (°)

2 4
R_f (%)

Depth (m)

E	: 394553	Cone no.	: 100648	Rig	: GEOScope
N	: 5903055,3	Cone type	: TSP	Performed by	: BVI/2014-03-26
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Sleeve

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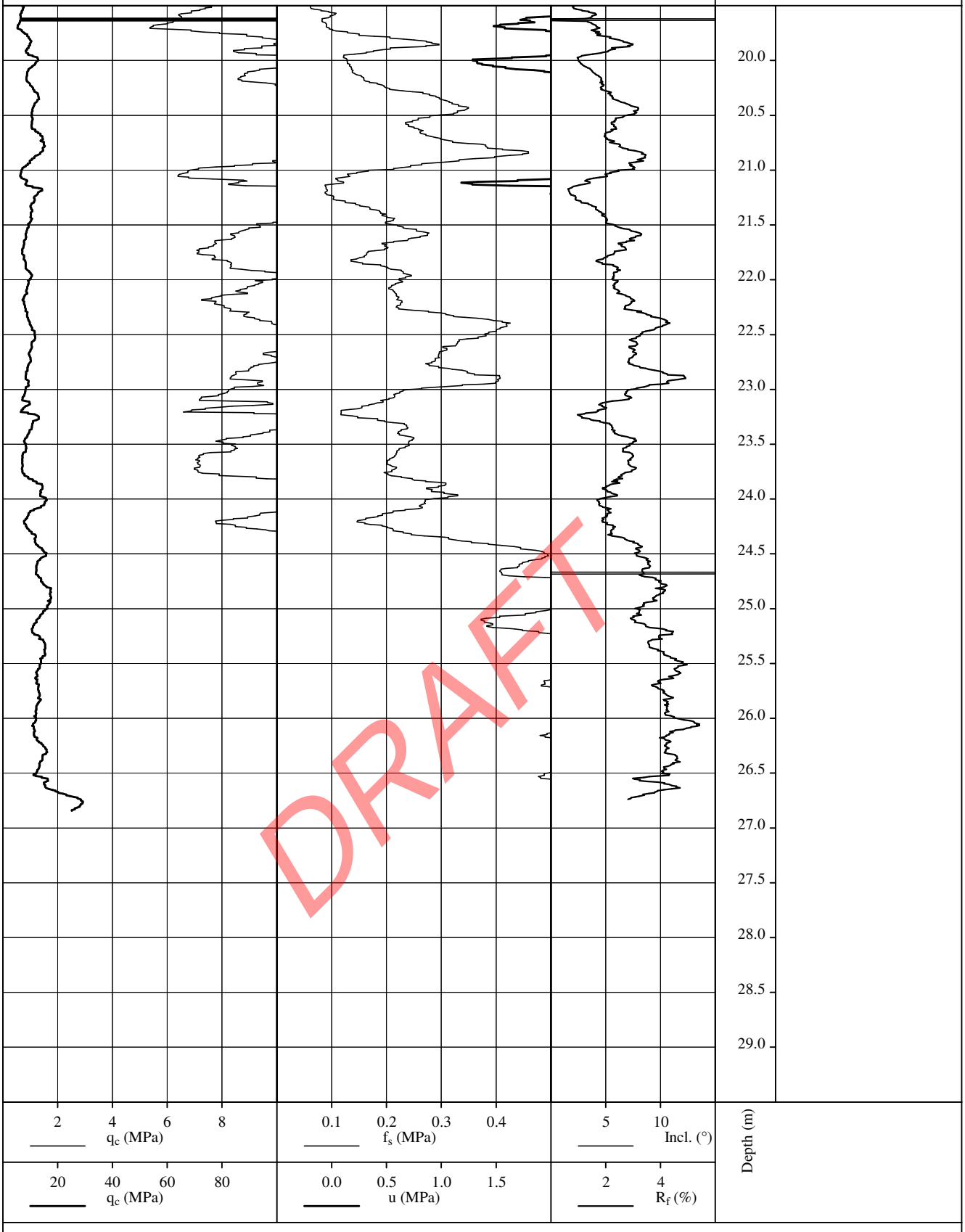

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N	: 5903055,3	Cone type	: TSP	Performed by	: BVI/2014-03-26
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Sleeve

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Prepared	: BVI	Date: 2014-03-26	Subject: ST14461-CPT60	
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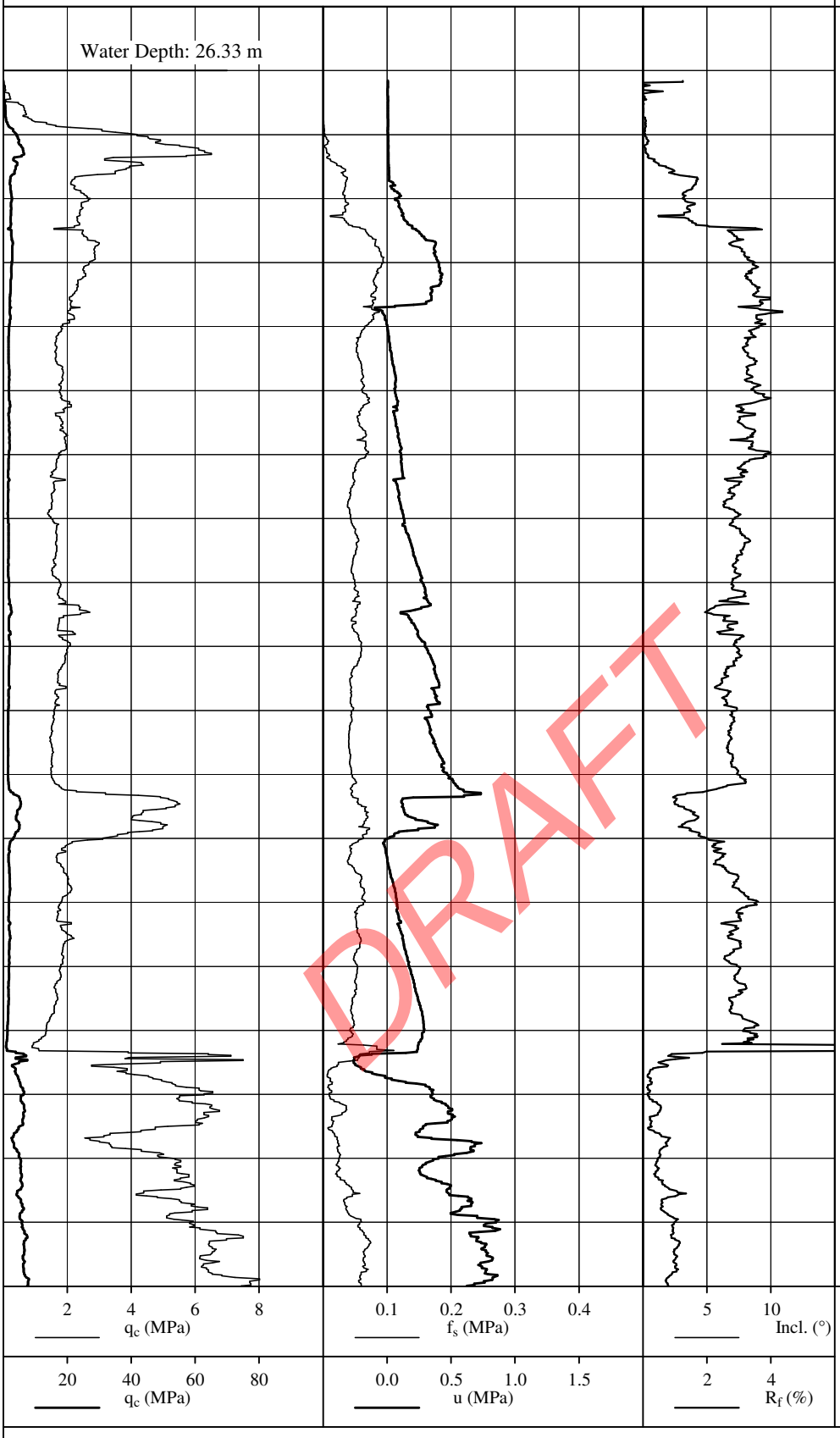
CPT name : ST14461-CPT61



E	: 393820,0	Cone no.	: 100648	Rig	: GEOScope
N	: 5903649,6	Cone type	: TSP	Performed by	: LEJ/2014-03-25
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Tip

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Prepared	: LEJ	Date: 2014-03-25	Subject: ST14461-CPT61	
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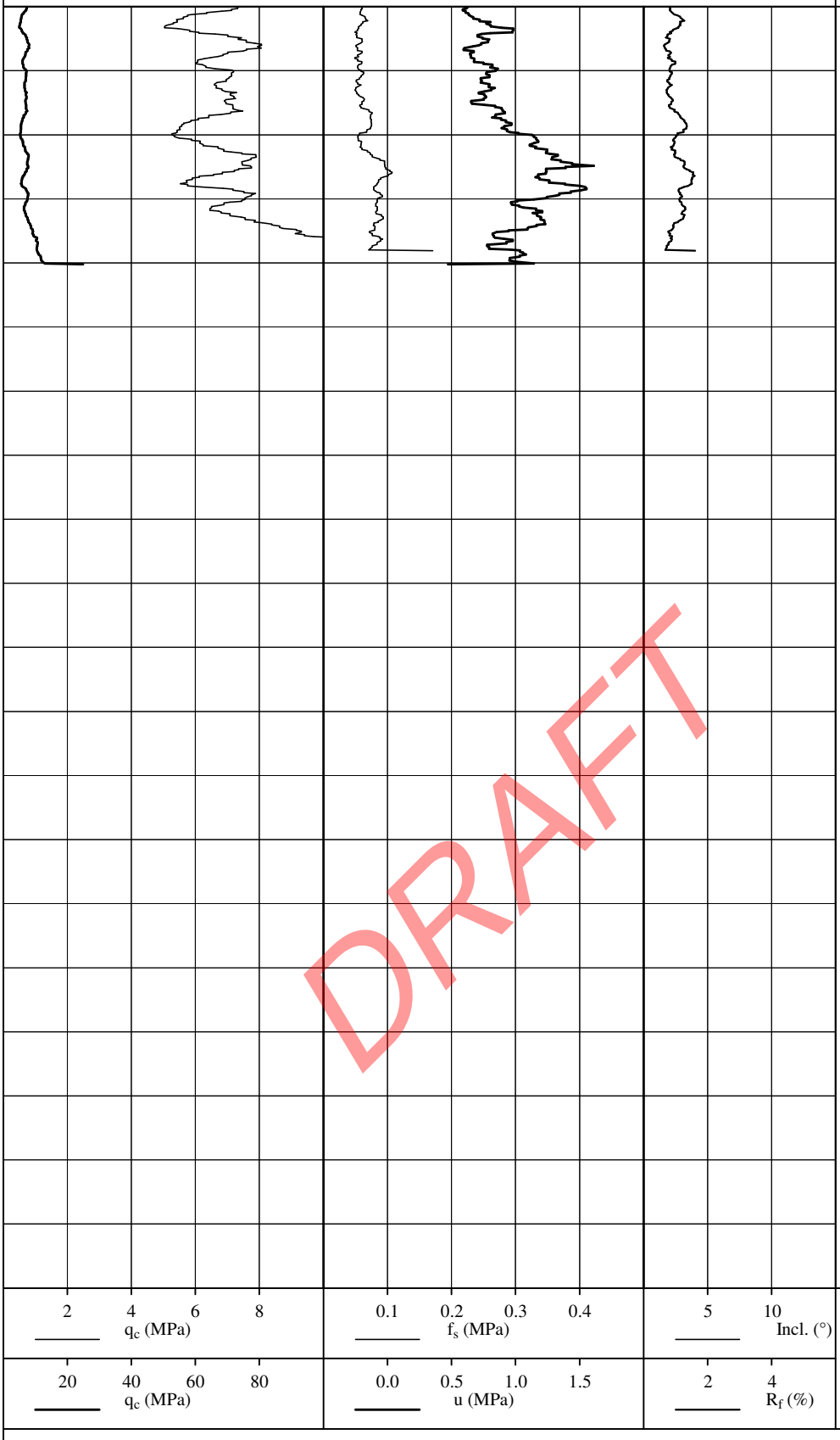
CPT name : ST14461-CPT61



2 4 6 8
q_c (MPa)

20 40 60 80
q_c (MPa)

0.1 0.2 0.3 0.4
f_s (MPa)

0.0 0.5 1.0 1.5
u (MPa)

5 10
Incl. (°)

2 4
R_f (%)

Depth (m)

E	: 393820,0	Cone no.	: 100648	Rig	: GEOScope
N	: 5903649,6	Cone type	: TSP	Performed by	: LEJ/2014-03-25
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Tip

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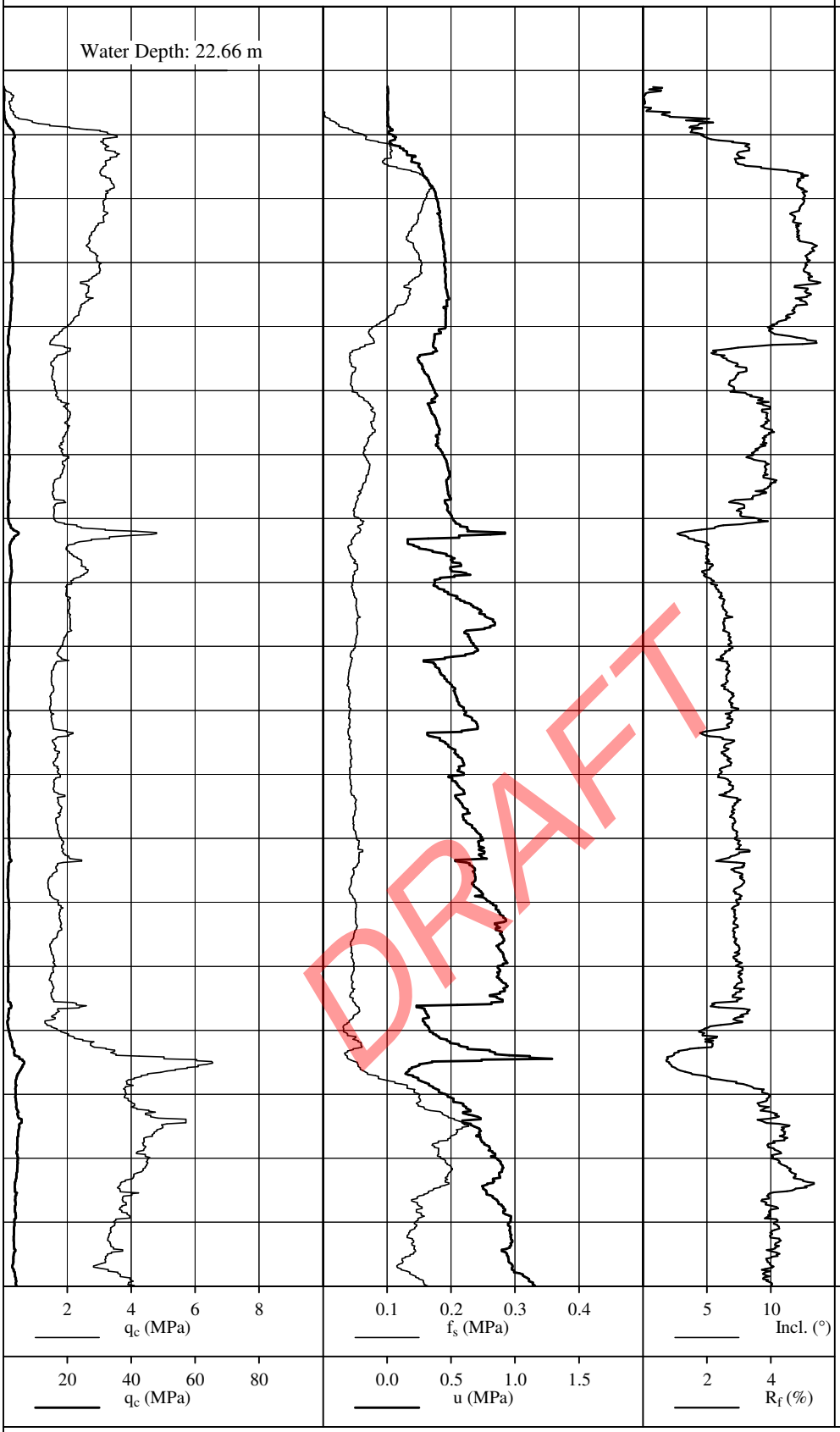
CPT name : ST14461-CPT66



E	: 390153,3	Cone no.	: 100648	Rig	: GEOScope
N	: 5906618,6	Cone type	: TSP	Performed by	: LEJ/2014-03-25
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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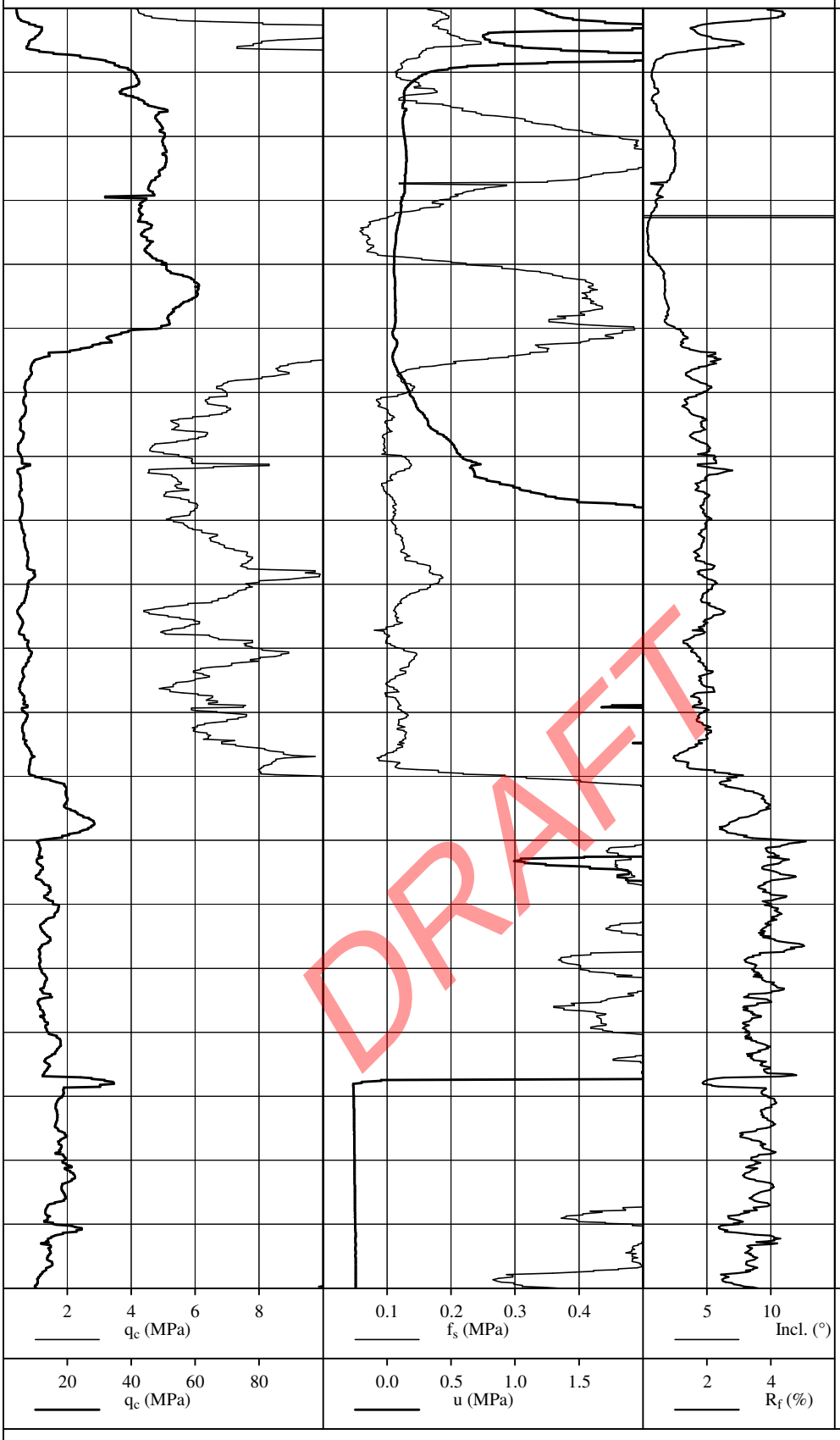
CPT name : ST14461-CPT66



2 4 6 8
q_c (MPa)

20 40 60 80
q_c (MPa)

0.1 0.2 0.3 0.4
f_s (MPa)

0.0 0.5 1.0 1.5
u (MPa)

5 10
Incl. (°)

2 4
R_f (%)

Depth (m)

E	: 390153,3	Cone no.	: 100648	Rig	: GEOScope
N	: 5906618,6	Cone type	: TSP	Performed by	: LEJ/2014-03-25
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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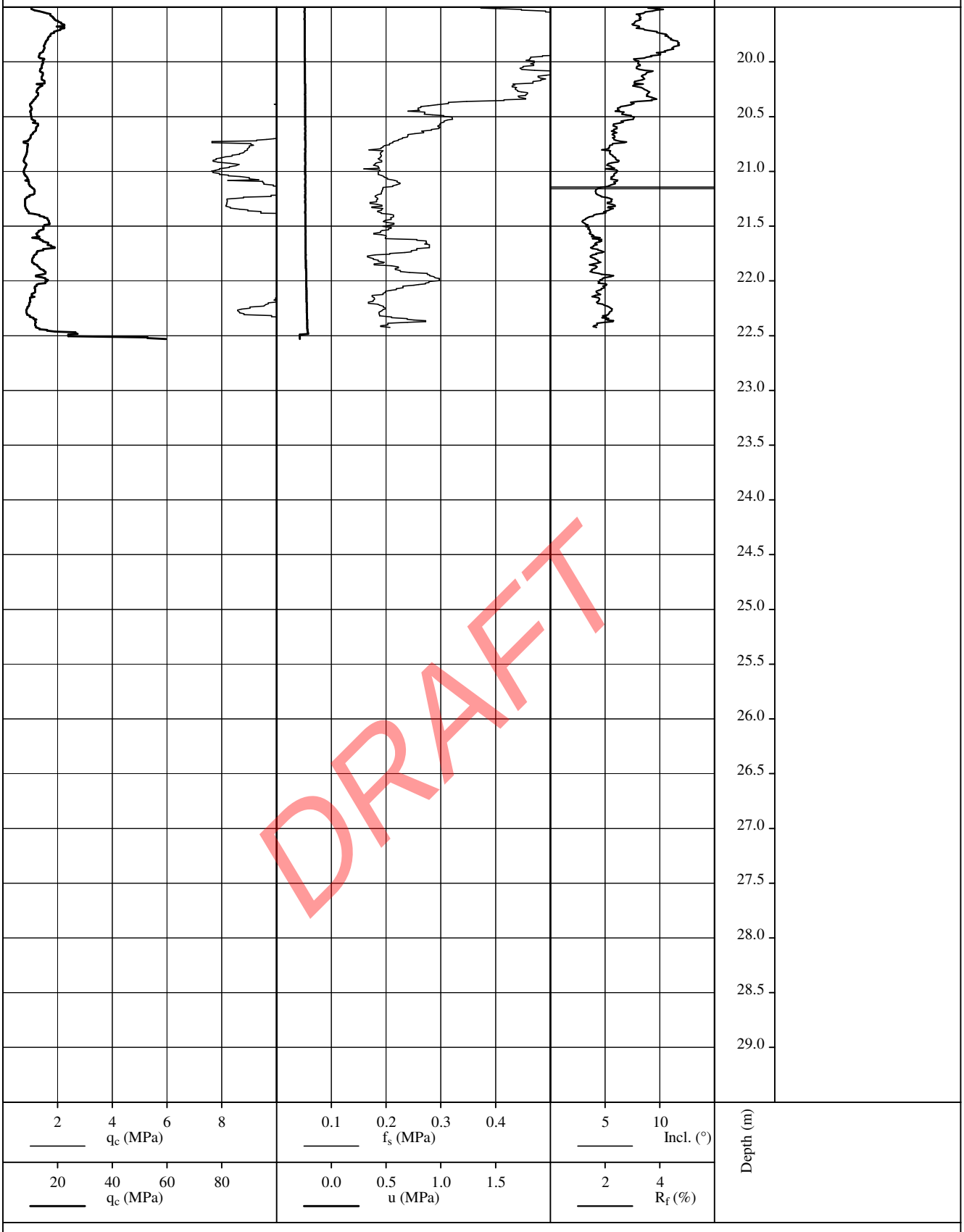

E	: 390153,3	Cone no.	: 100648	Rig	: GEOScope
N	: 5906618,6	Cone type	: TSP	Performed by	: LEJ/2014-03-25
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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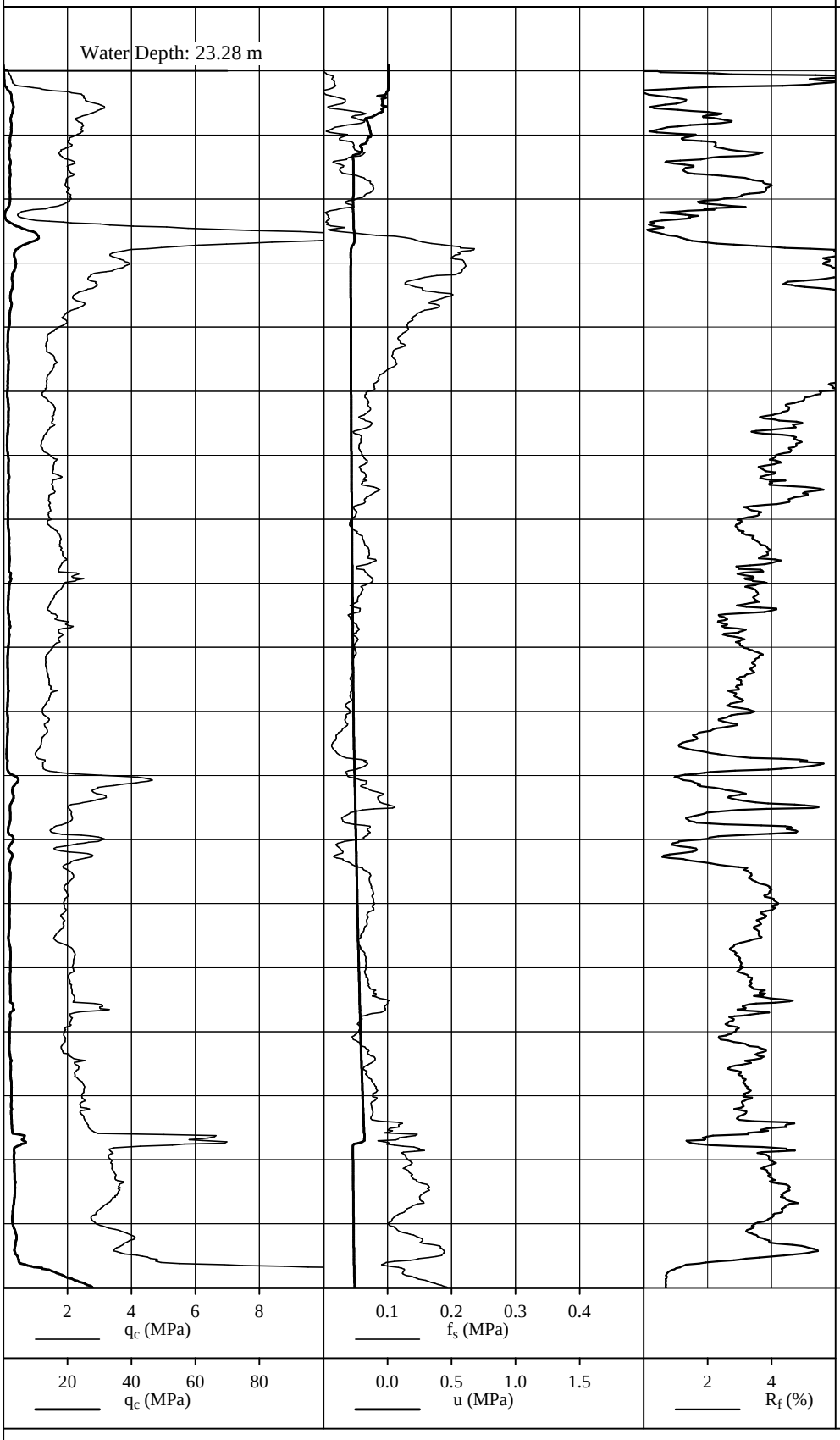
CPT name : ST14461-CPT68



E	: 391870,3	Cone no.	: 130811	Rig	: GEOScope
N	: 5902954,9	Cone type	: TSP	Performed by	: LEJ/2014-03-13 21:04:46
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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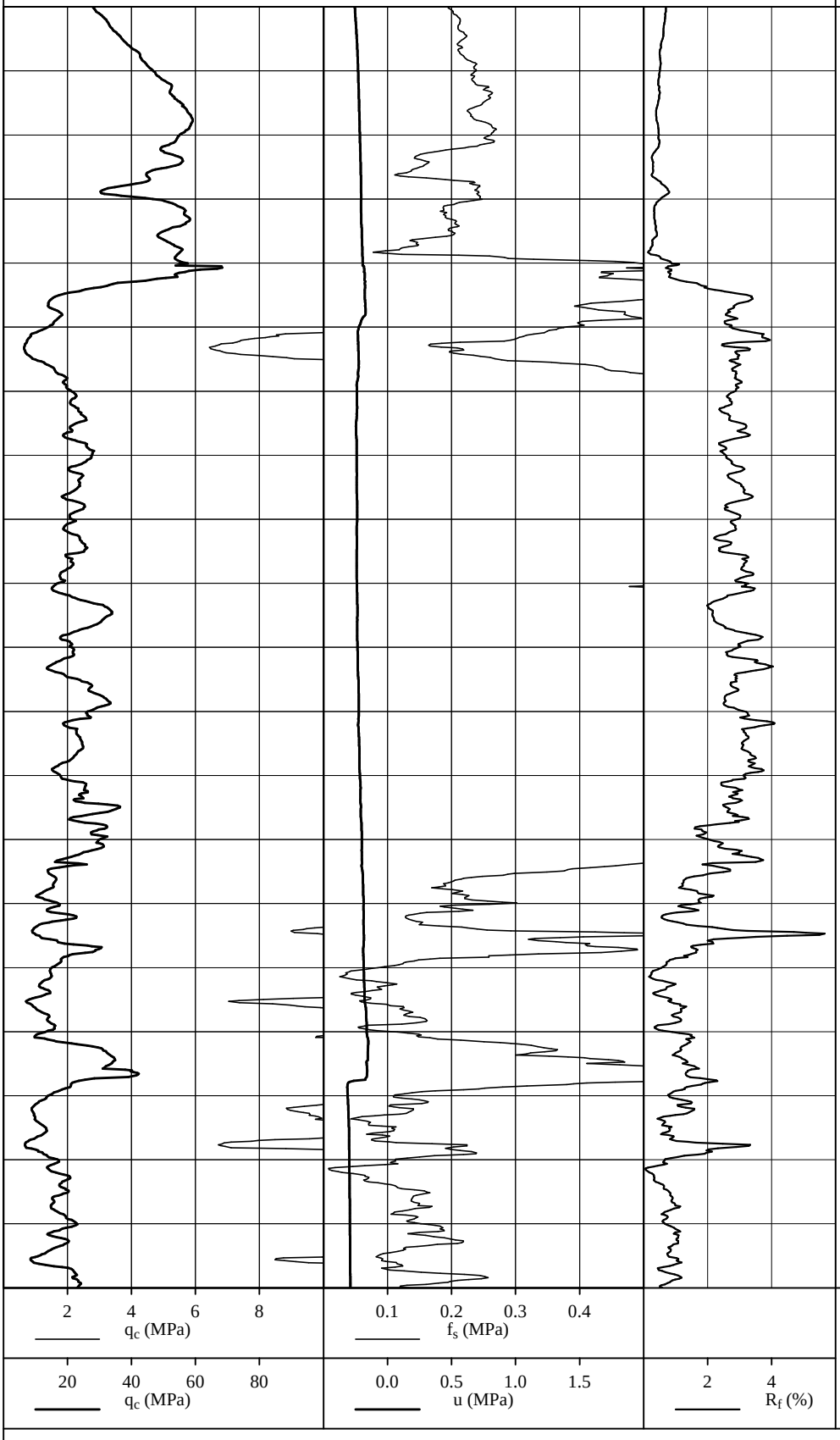
CPT name : ST14461-CPT68



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System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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Prepared	: KNM	Date: 2014-03-14	Subject: ST14461-CPT68	
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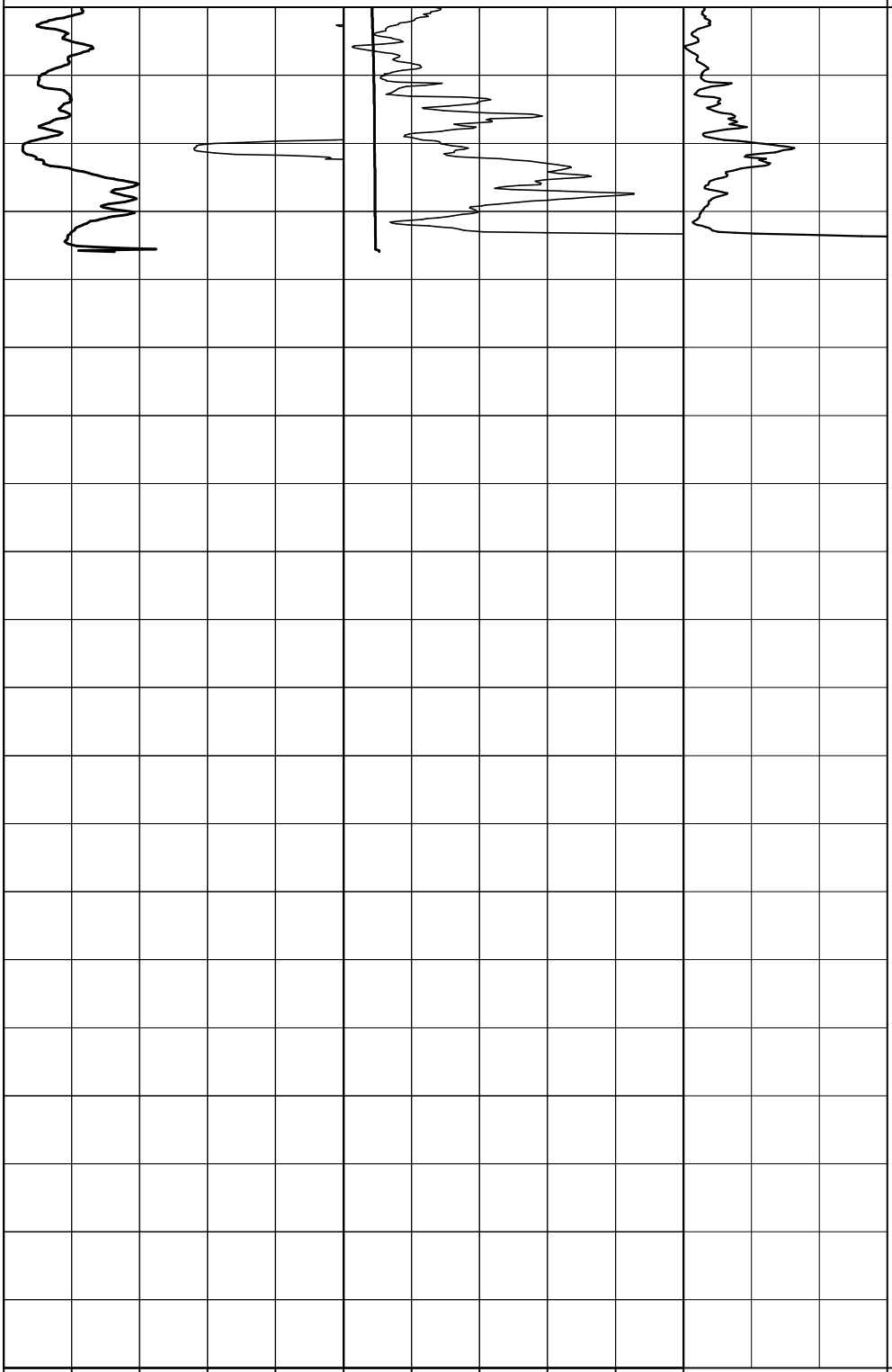
CPT name : ST14461-CPT68



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Prepared	: KNM	Date: 2014-03-14	Subject: ST14461-CPT68	
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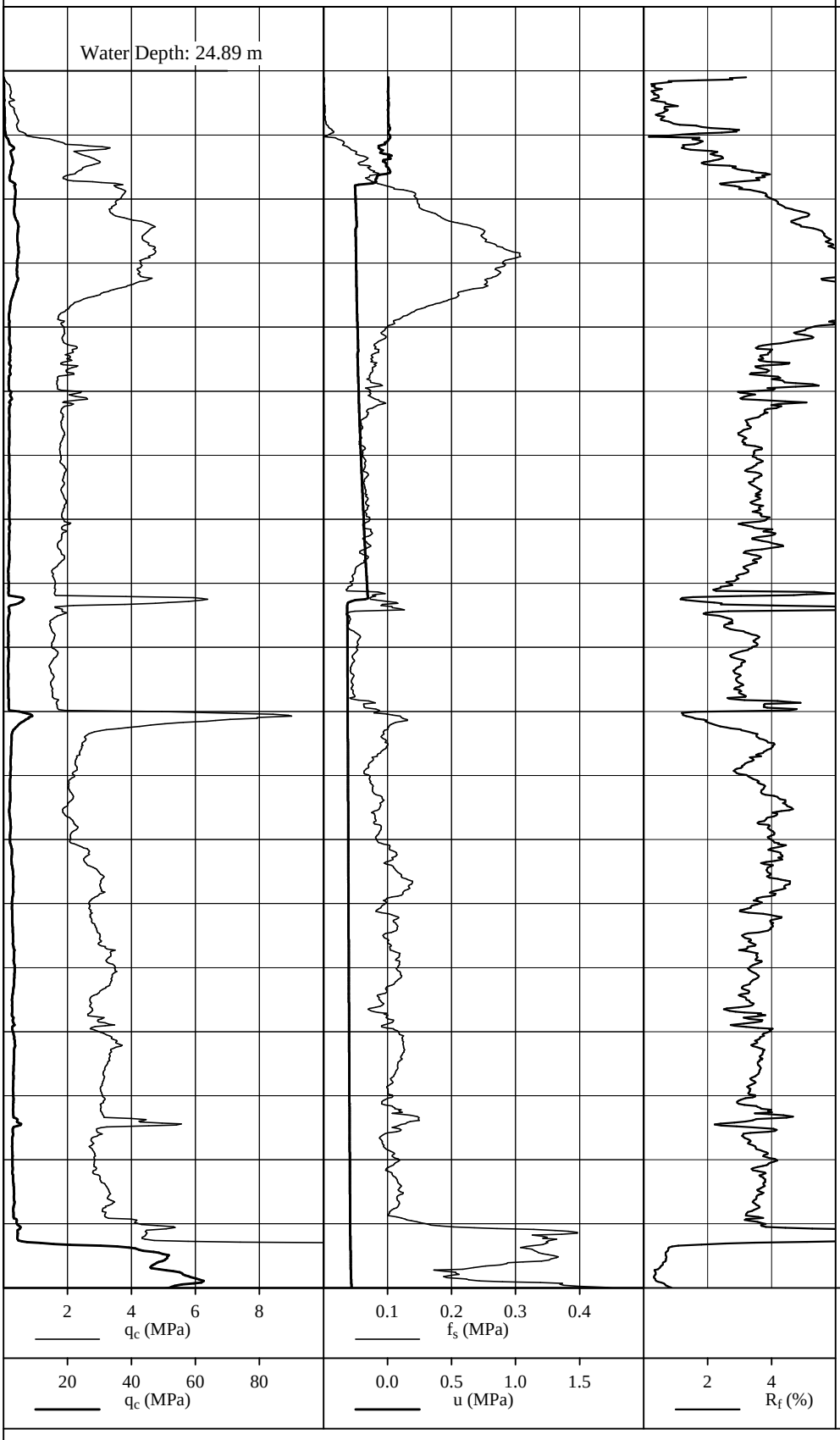
CPT name : ST14461-CPT69



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System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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Prepared	: KNM	Date: 2014-03-14	Subject: ST14461-CPT69	
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Perceptor - 1.5.10.120

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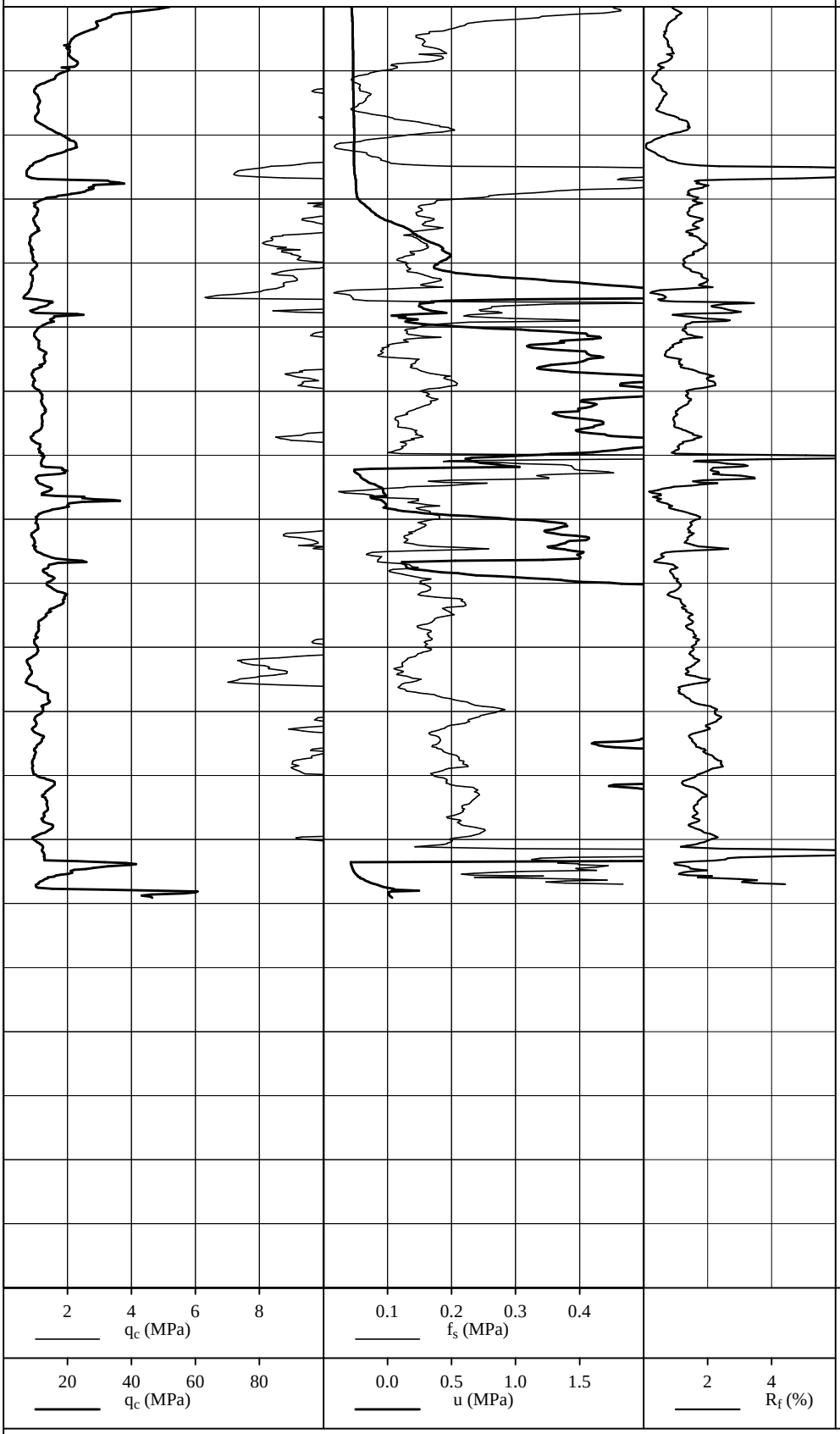
CPT name : ST14461-CPT69



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Prepared	: KNM	Date: 2014-03-14	Subject: ST14461-CPT69		
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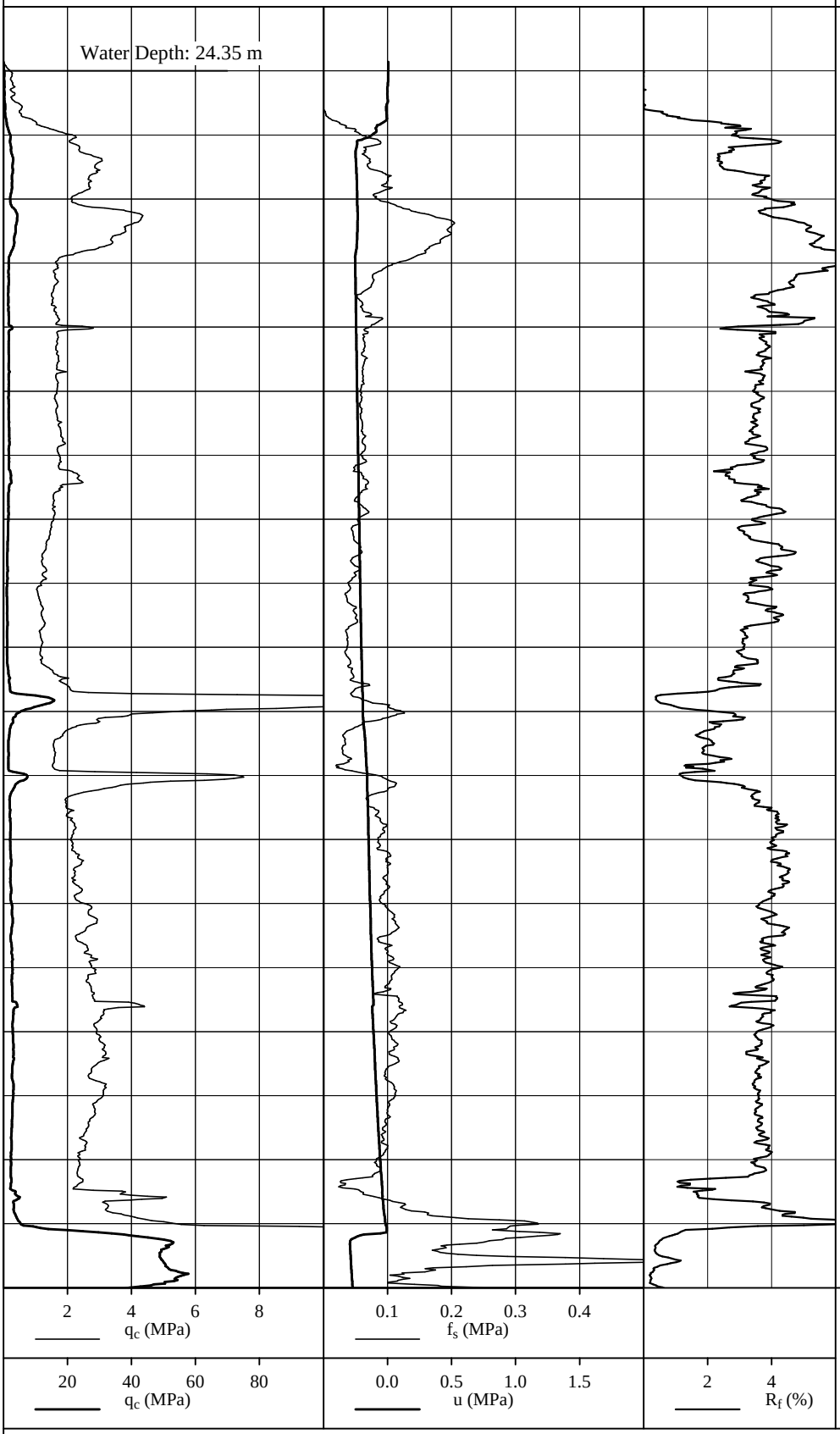
Perceptor - 1.5.10.120

Printed 2014-03-14 03:51:33

CPT name : ST14461-CPT69a



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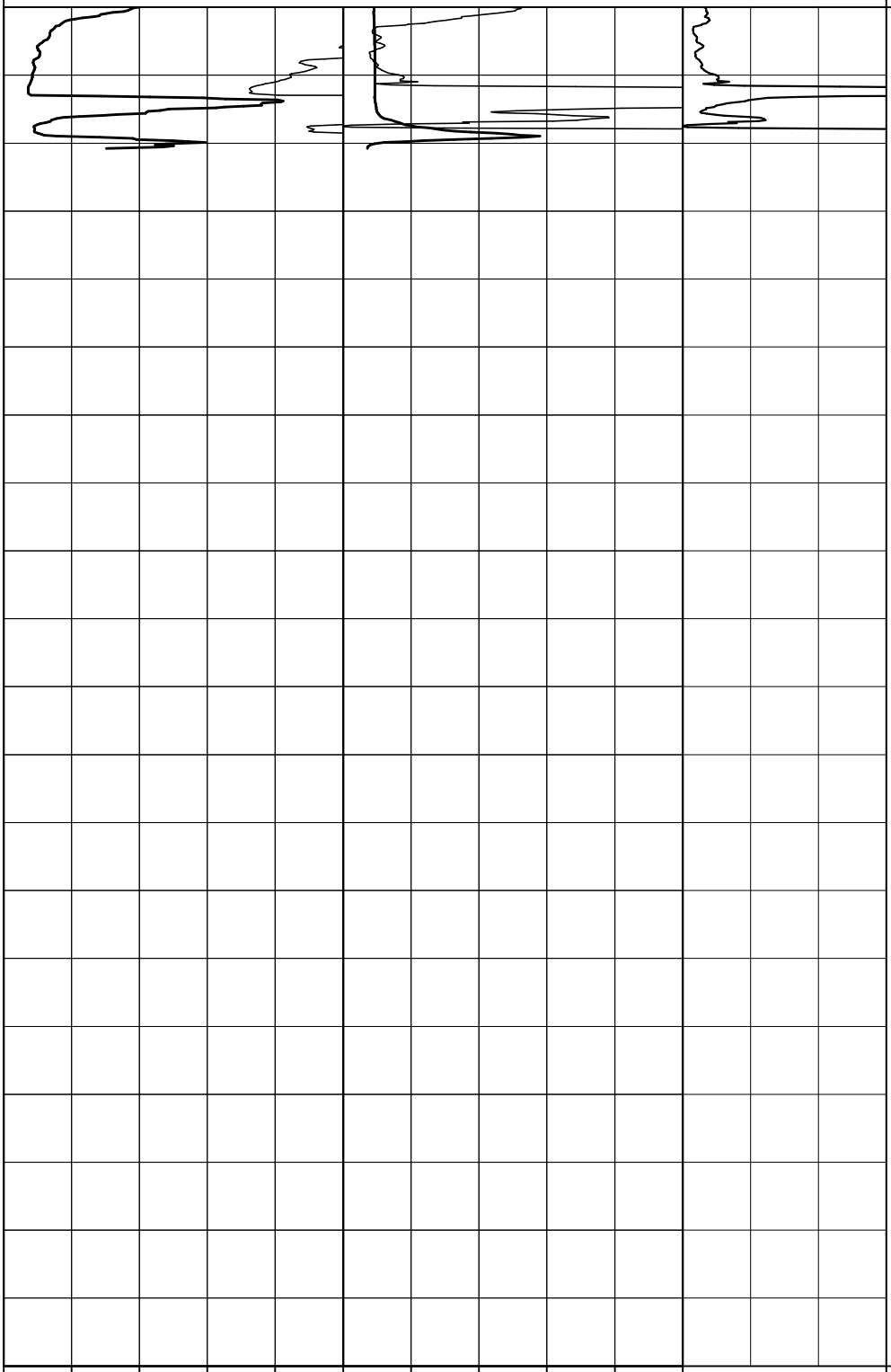
CPT name : ST14461-CPT69a



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Prepared	: KNM	Date: 2014-03-14	Subject: ST14461-CPT69a	
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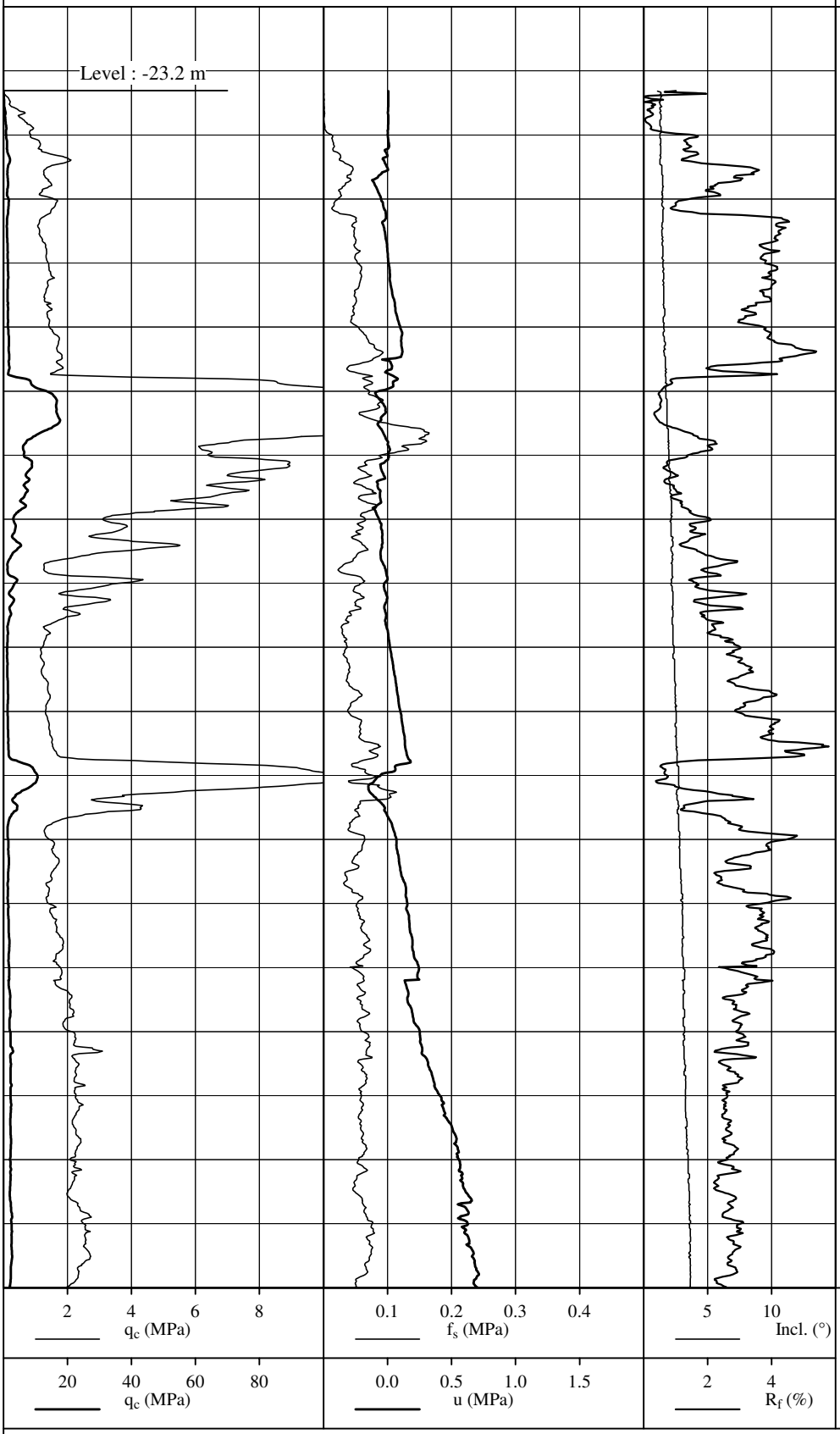
CPT name : ST14461-CPT7



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System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT7	
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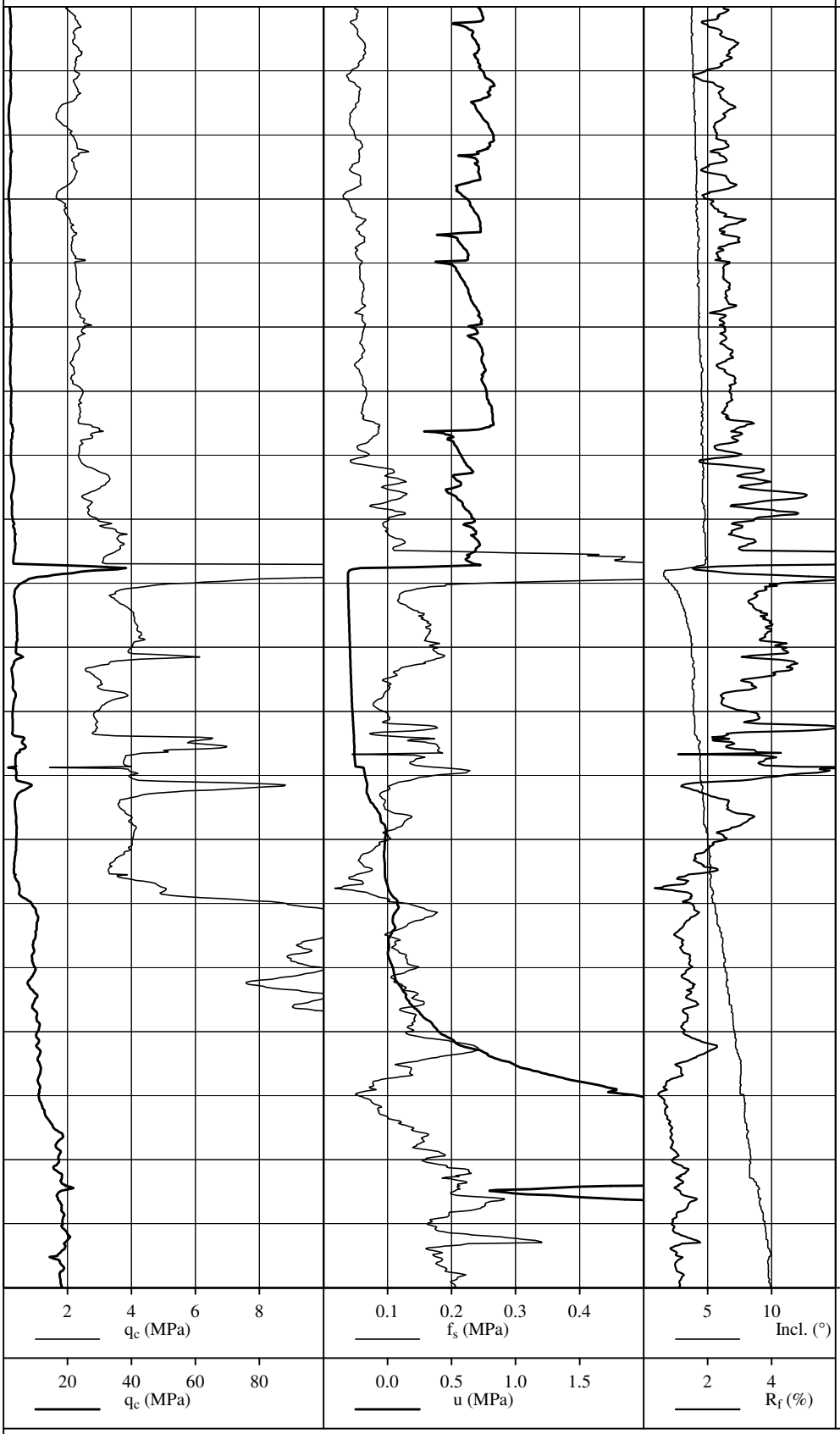
CPT name : ST14461-CPT7



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Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT7		
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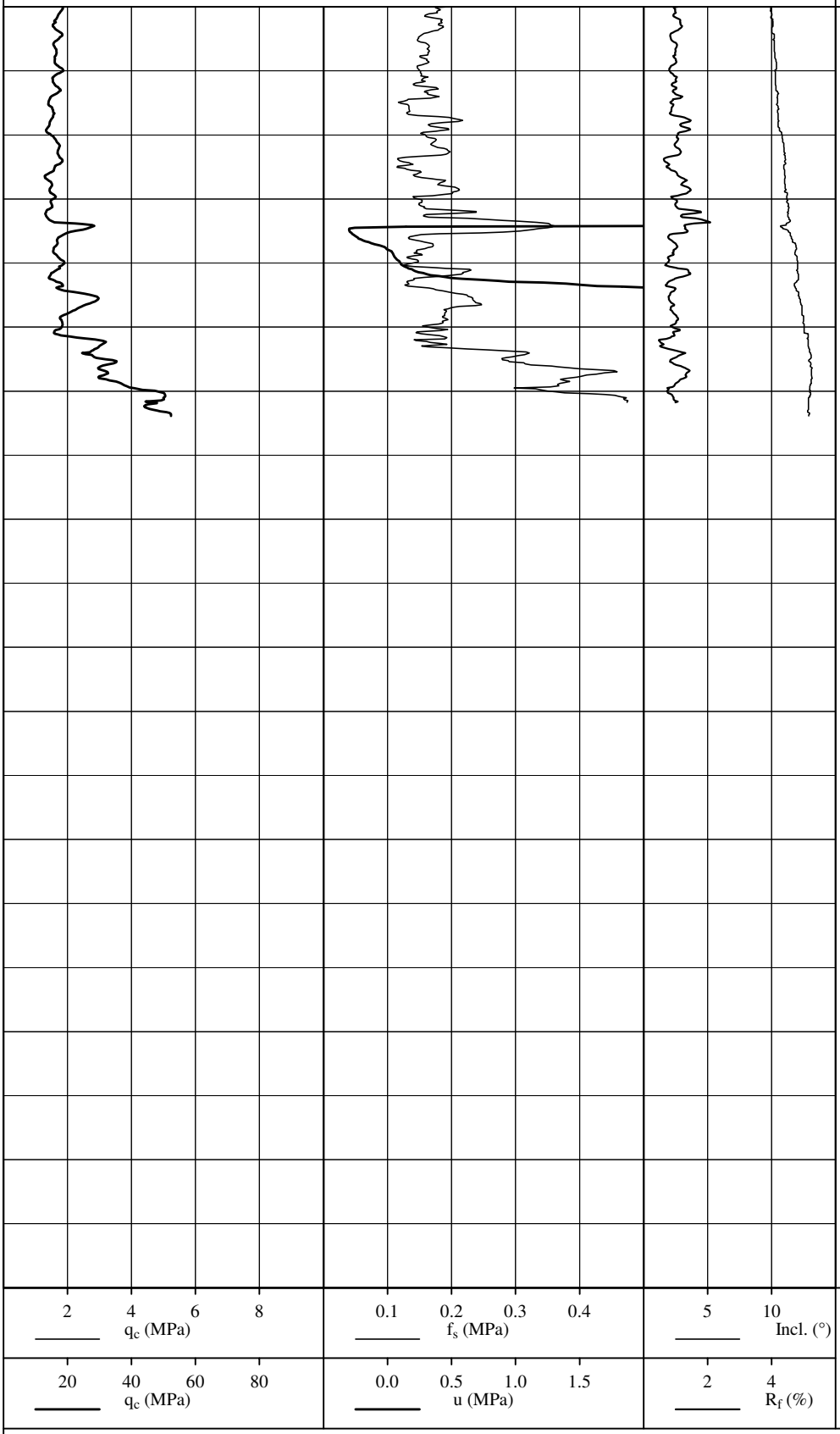
CPT name : ST14461-CPT7



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Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT7	
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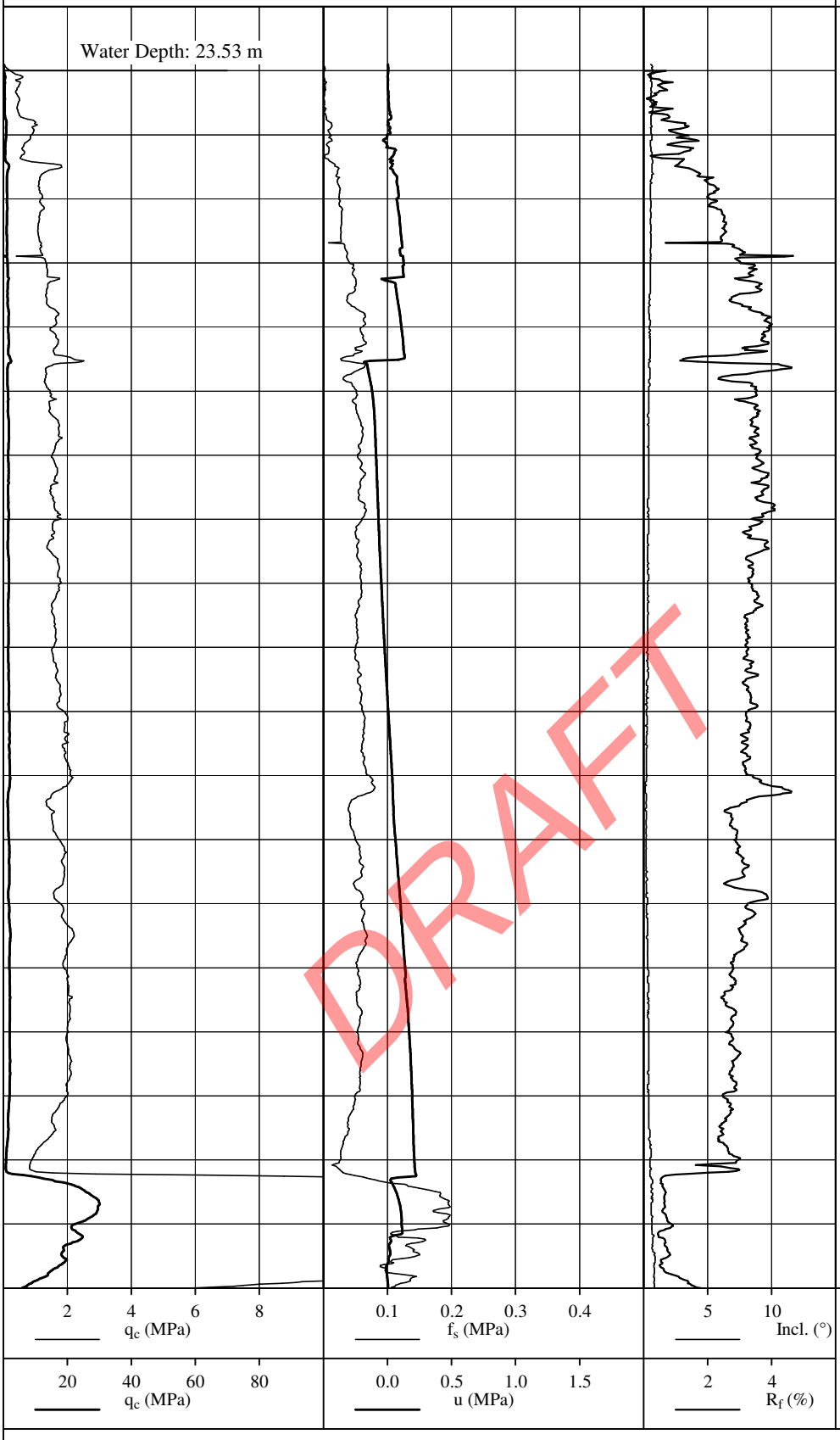
CPT name : ST14461-CPT70



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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max thrust

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Prepared	: BVI	Date: 2014-03-23	Subject: ST14461-CPT70	
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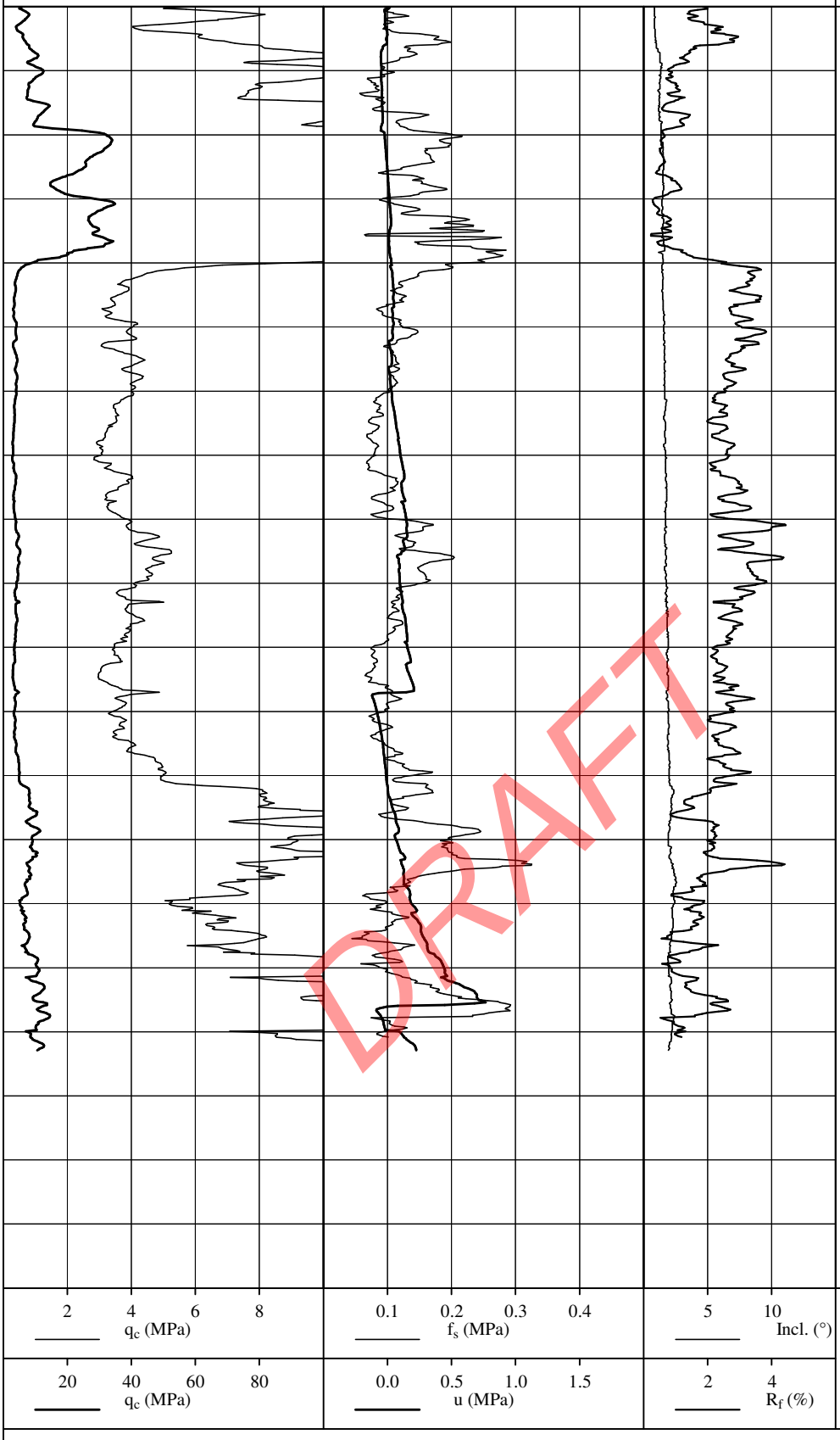
Printed 2014-03-23 14:34:33

CPT name : ST14461-CPT70



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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max thrust

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Prepared	: BVI	Date: 2014-03-23	Subject: ST14461-CPT70	
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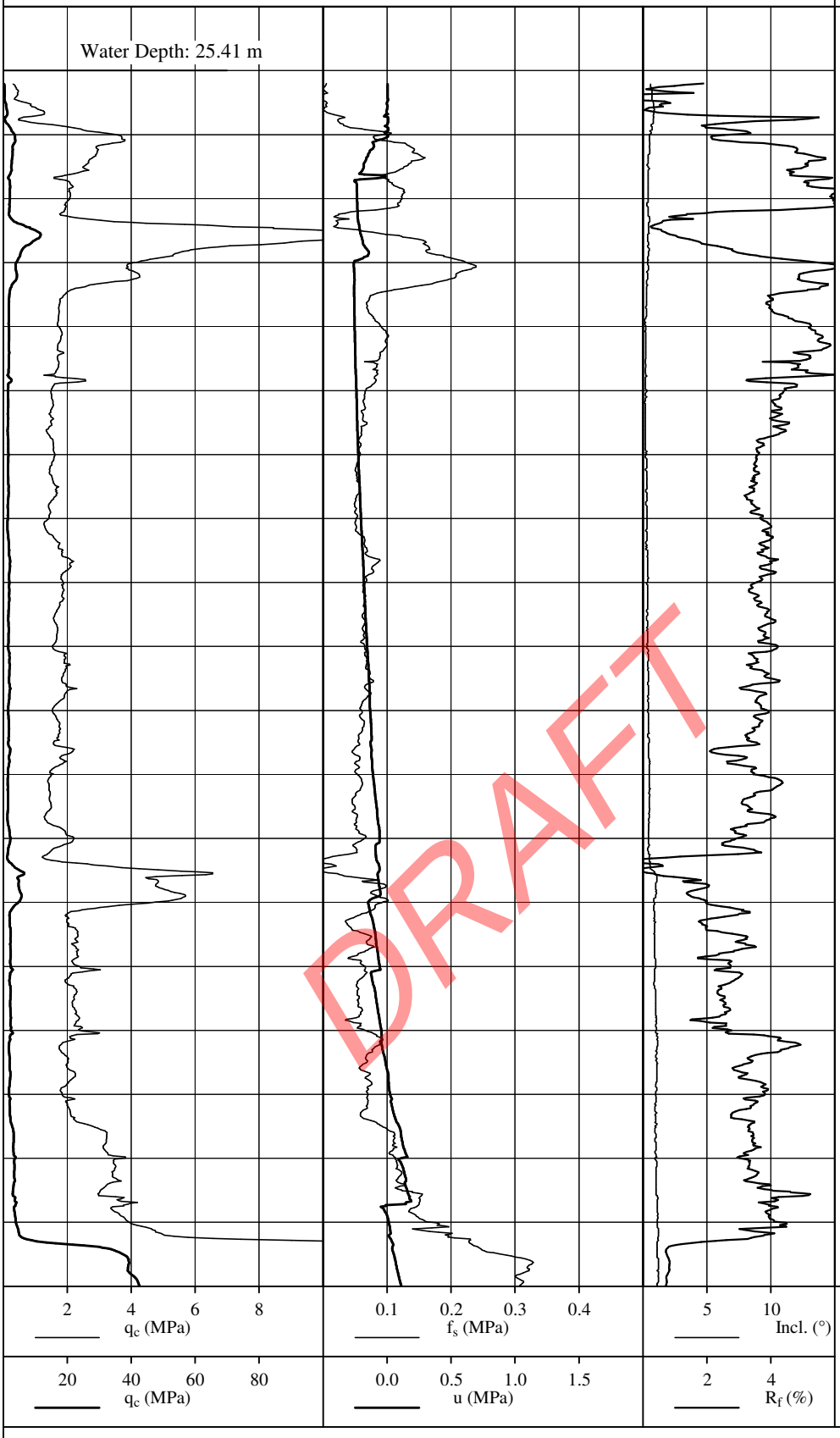
CPT name : ST14461-CPT71a



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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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Prepared	: LEJ	Date: 2014-03-22	Subject: ST14461-CPT71a	
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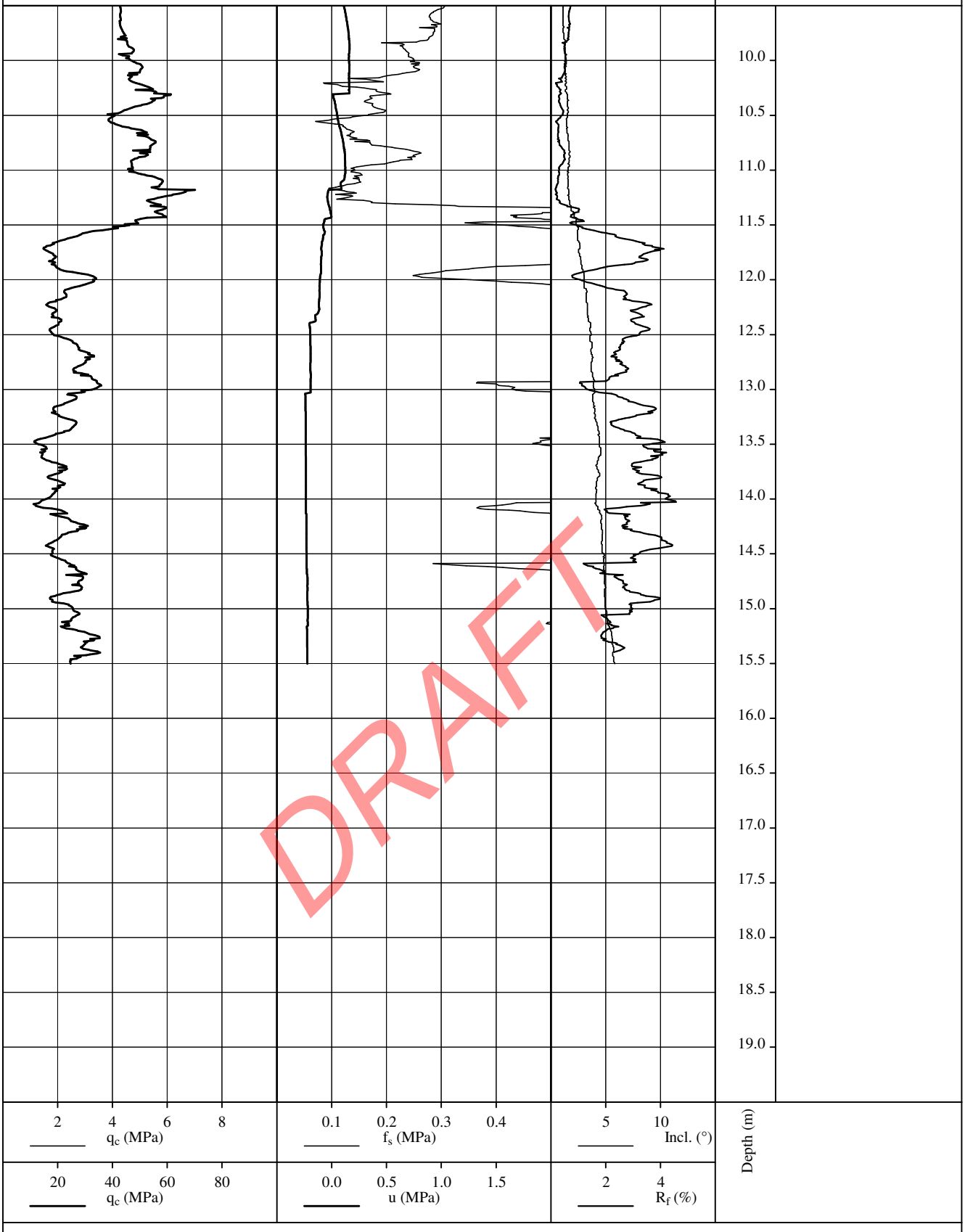
Approved	:	Date: 2014-03-22	Report Enclosure: ST14461-CPT71a	Rev.

Printed 2014-03-22 22:38:59

CPT name : ST14461-CPT71a



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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: LEJ	Date: 2014-03-22	Subject: ST14461-CPT71a	
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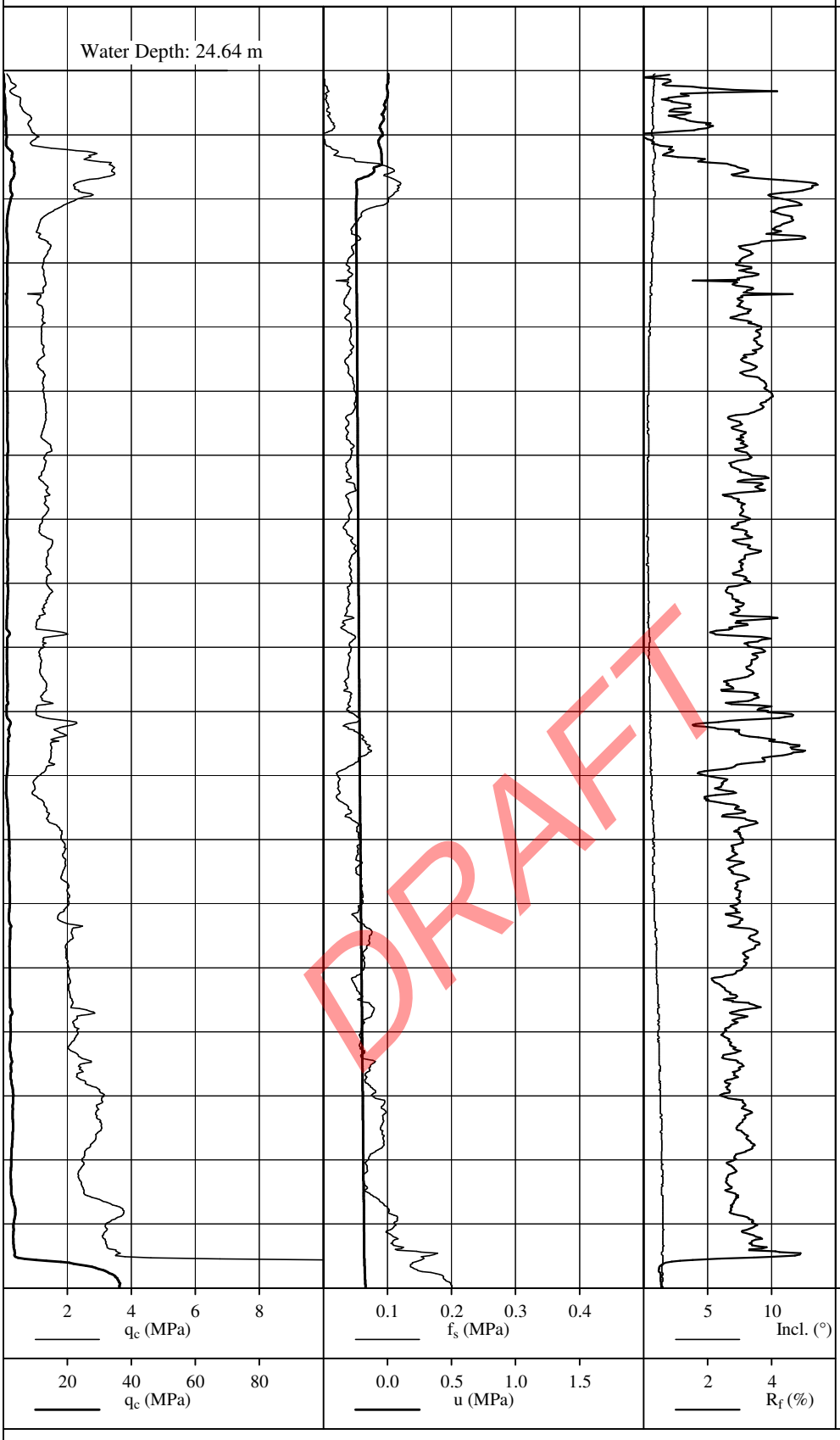
CPT name : ST14461-CPT72



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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: JPM	Date: 2014-03-23	Subject: ST14461-CPT72	
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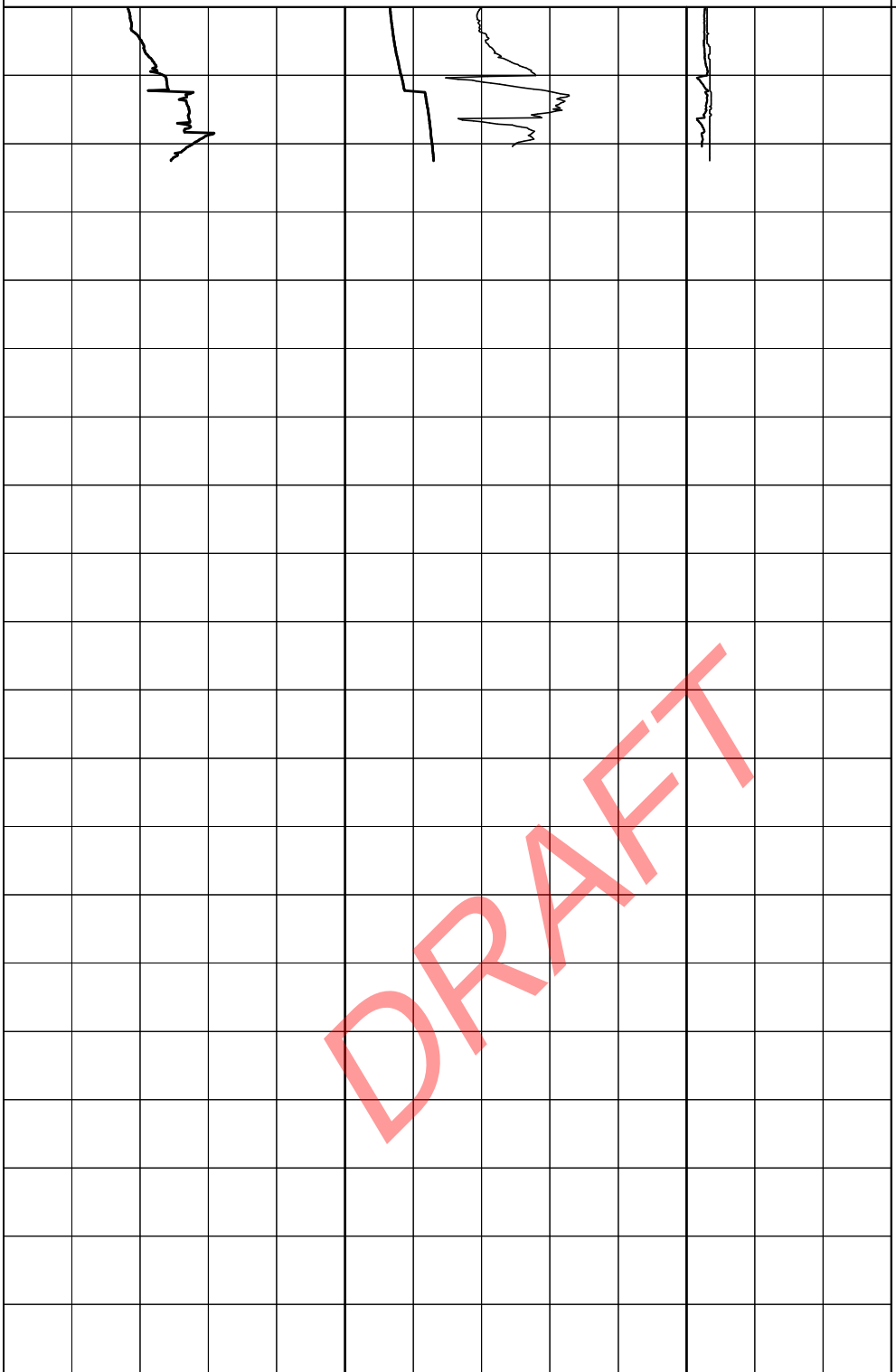
CPT name : ST14461-CPT72



q_c (MPa)	f_s (MPa)	Incl. (°)	Depth (m)
2 4 6 8	0.1 0.2 0.3 0.4	5 10	
20 40 60 80	0.0 0.5 1.0 1.5	2 4	
q_c (MPa)	u (MPa)	R_f (%)	

E	: 391884,6	Cone no.	: 130706	Rig	: GEOScope
N	: 5902957,5	Cone type	: TSP	Performed by	: JPM/2014-03-23
System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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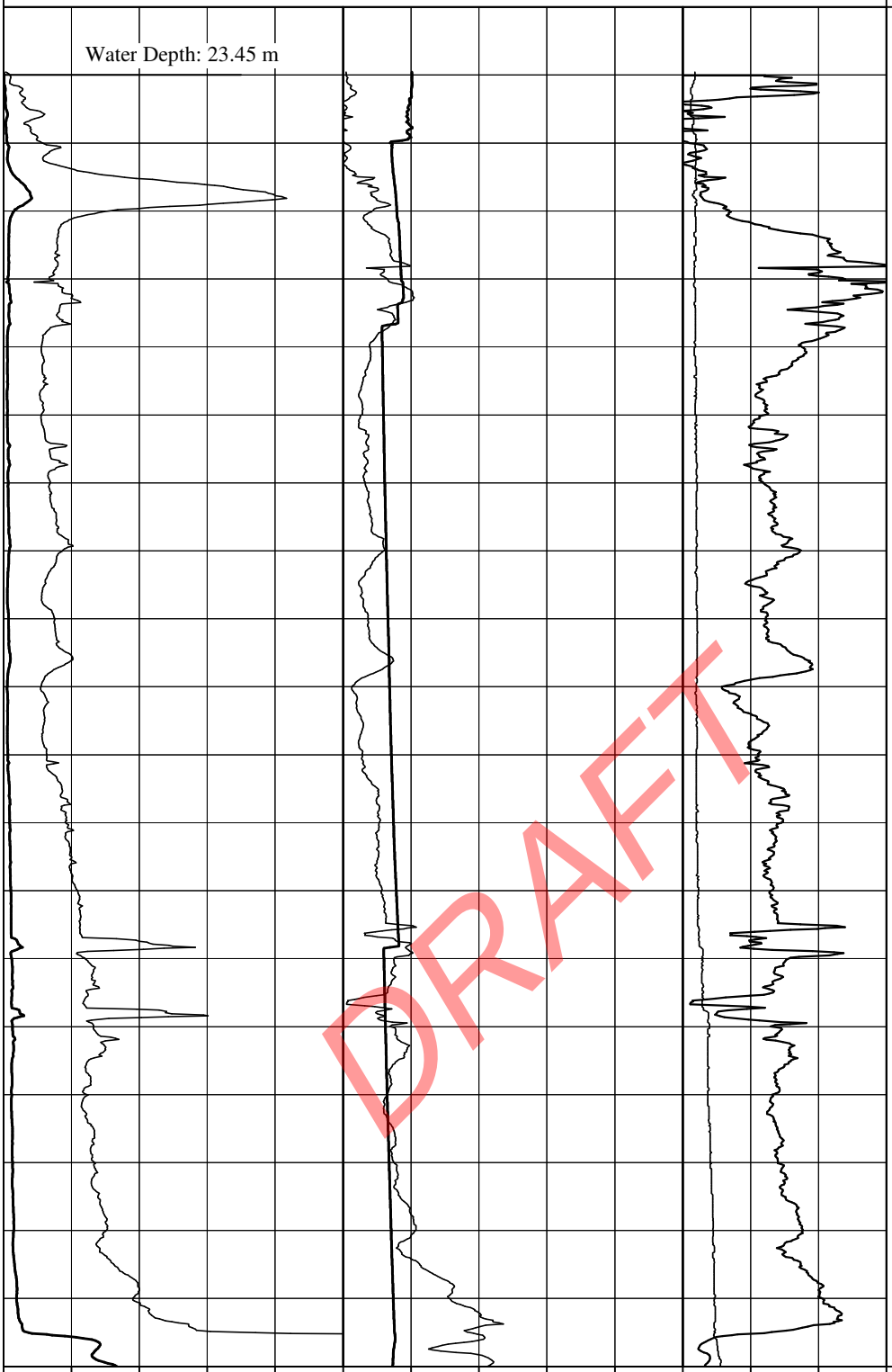
CPT name : ST14461-CPT73



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System	: UTM31/WGS 84	Cone area	: 10.0 cm^2	Remark	: Max Thrust

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Prepared	: JPM	Date: 2014-03-23	Subject: ST14461-CPT73		
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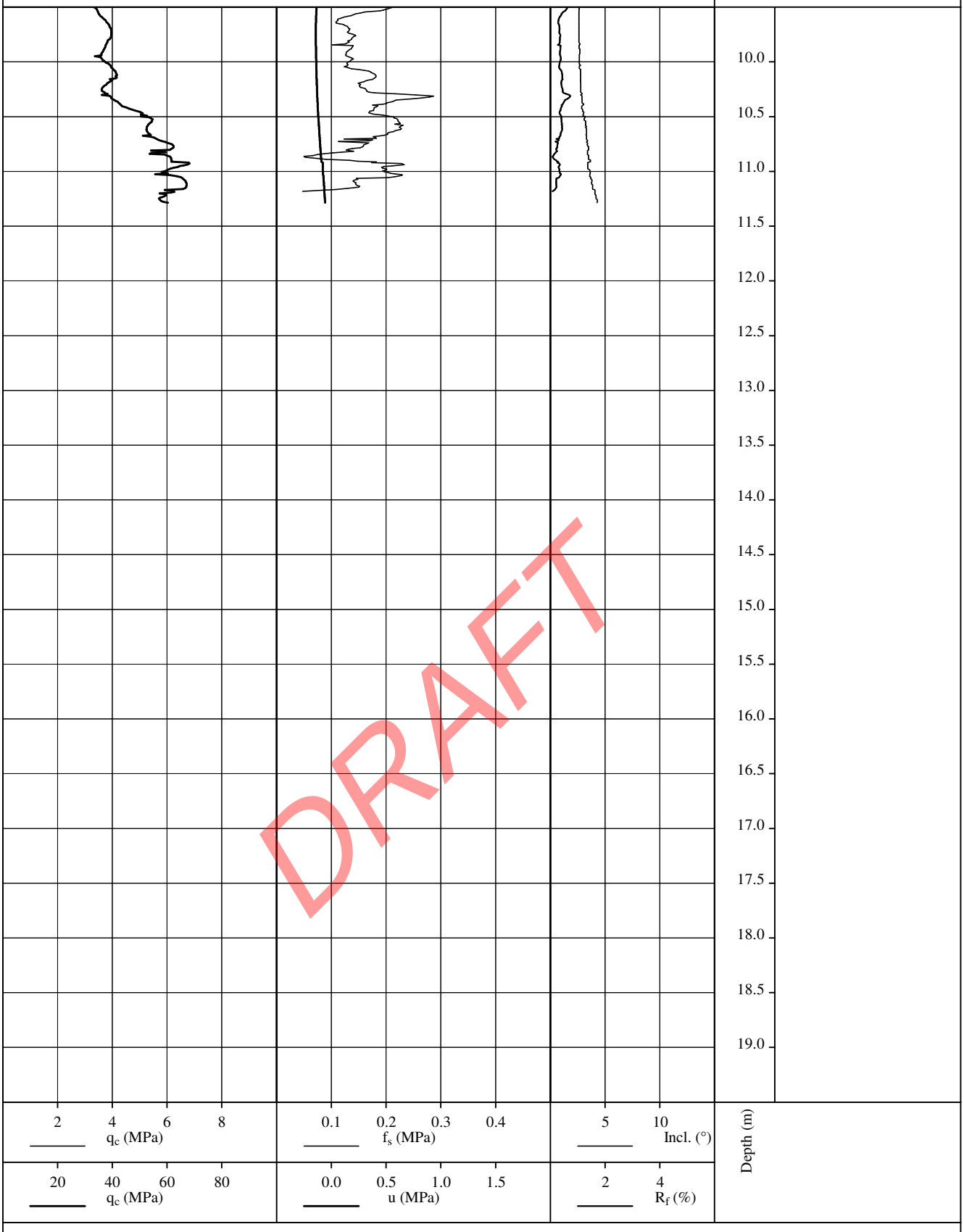
CPT name : ST14461-CPT73



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Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: JPM	Date: 2014-03-23	Subject: ST14461-CPT73	
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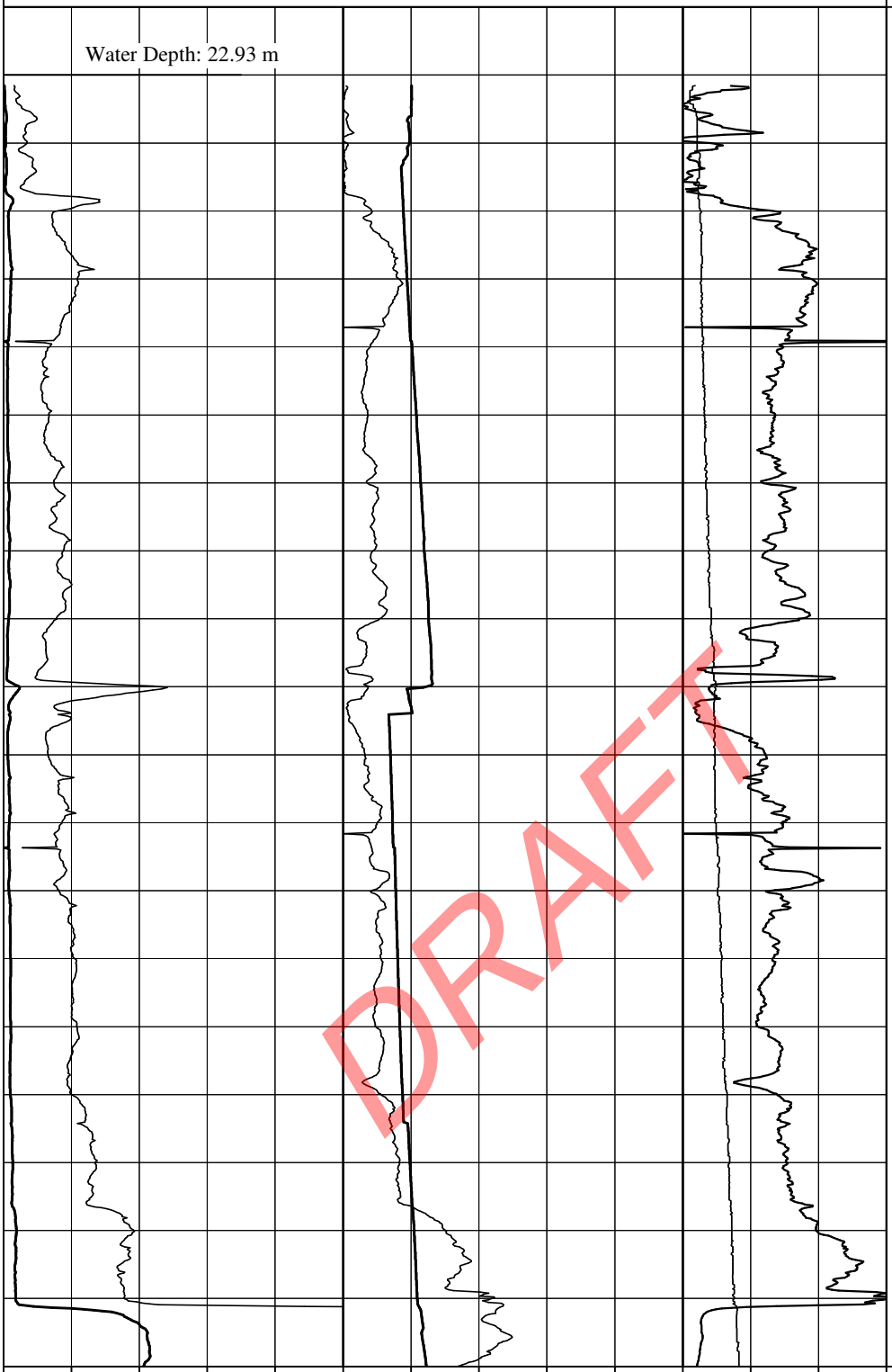
CPT name : ST14461-CPT74



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Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: JPM	Date: 2014-03-23	Subject: ST14461-CPT74	
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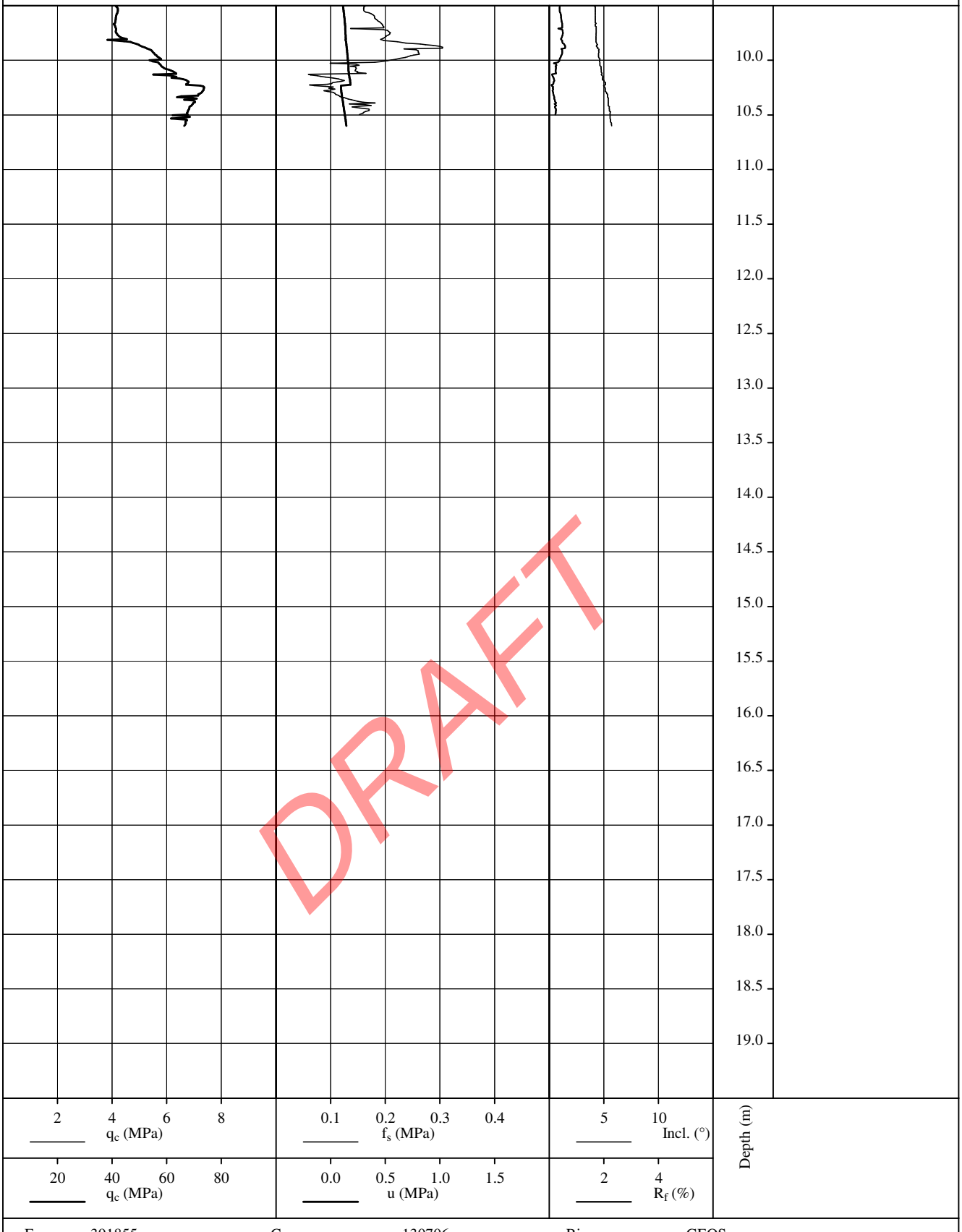
CPT name : ST14461-CPT74



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Prepared	: JPM	Date: 2014-03-23	Subject: ST14461-CPT74	
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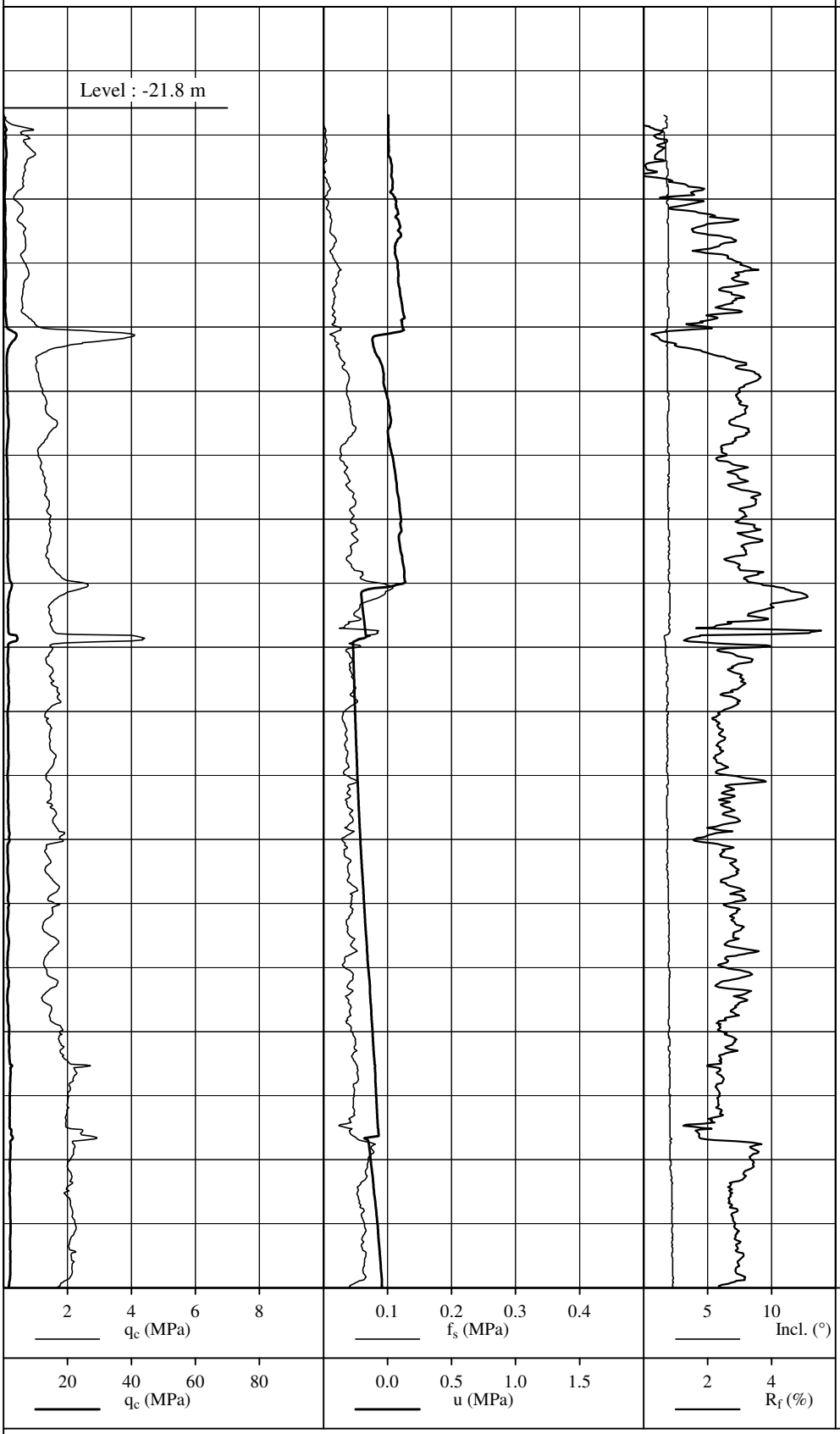
Perceptor - 1.5.10.102

CPT name : ST14461-CPT8



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GEO Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT8		
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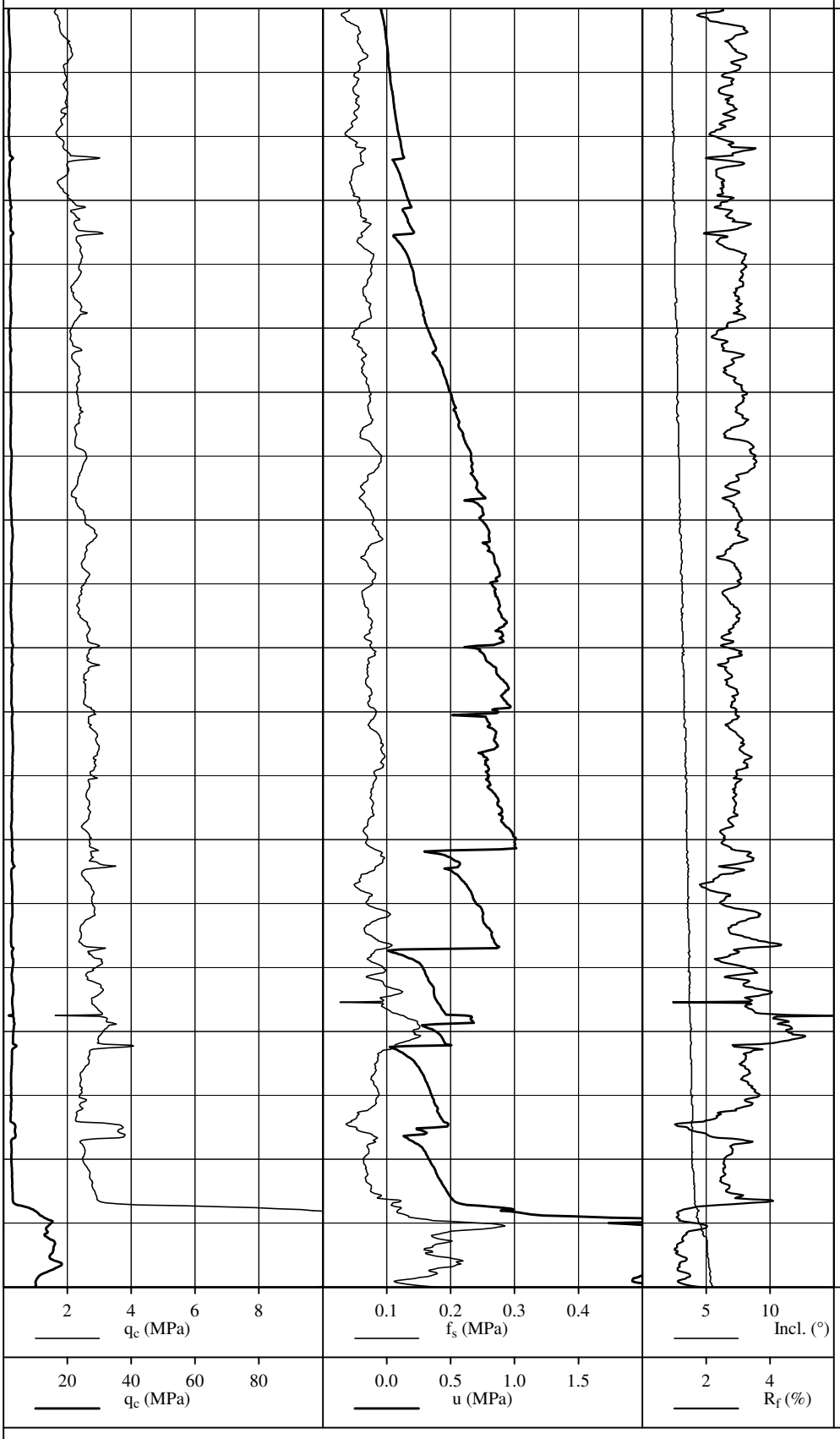
CPT name : ST14461-CPT8



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System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT8		
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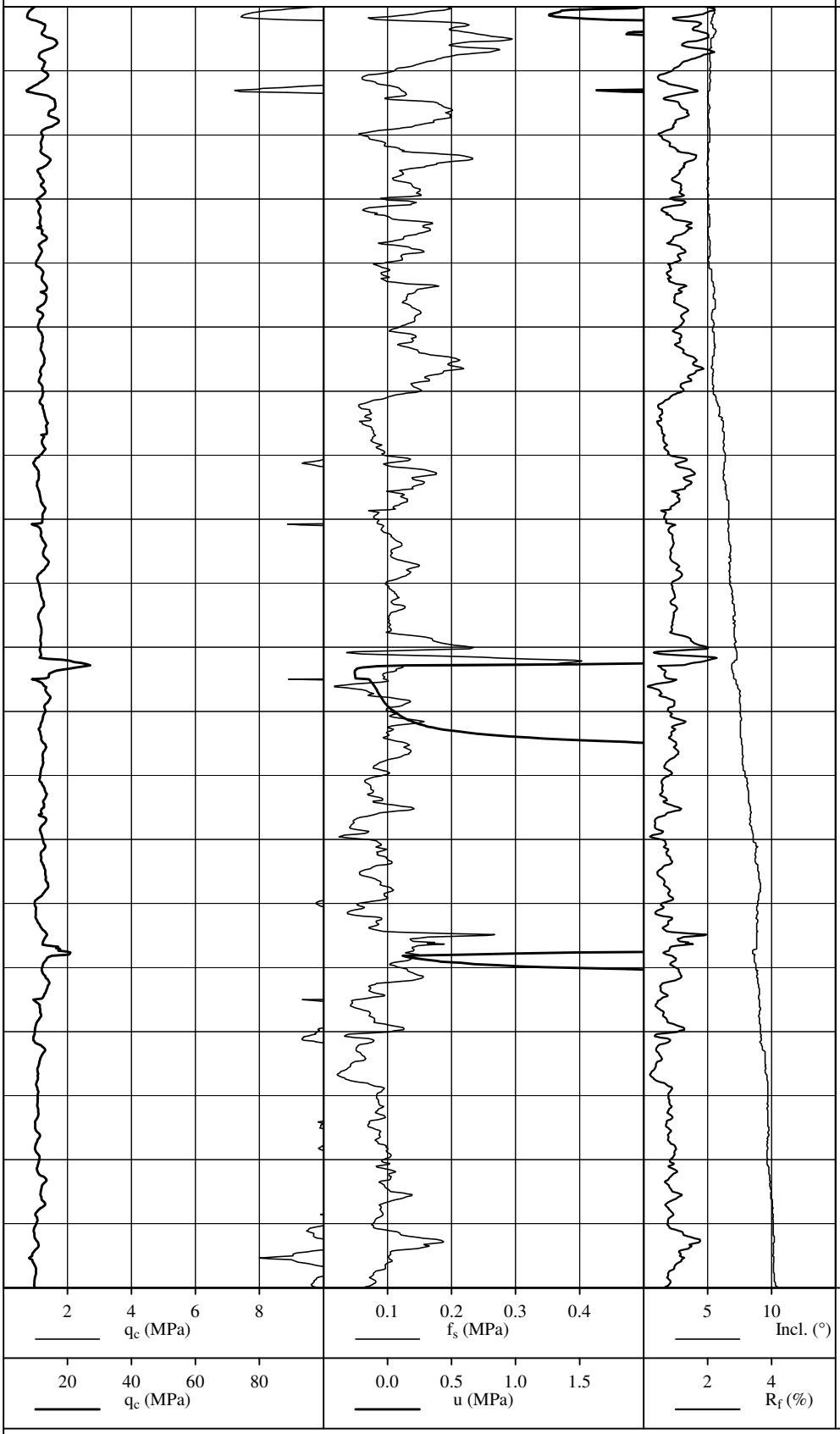
CPT name : ST14461-CPT8



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System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

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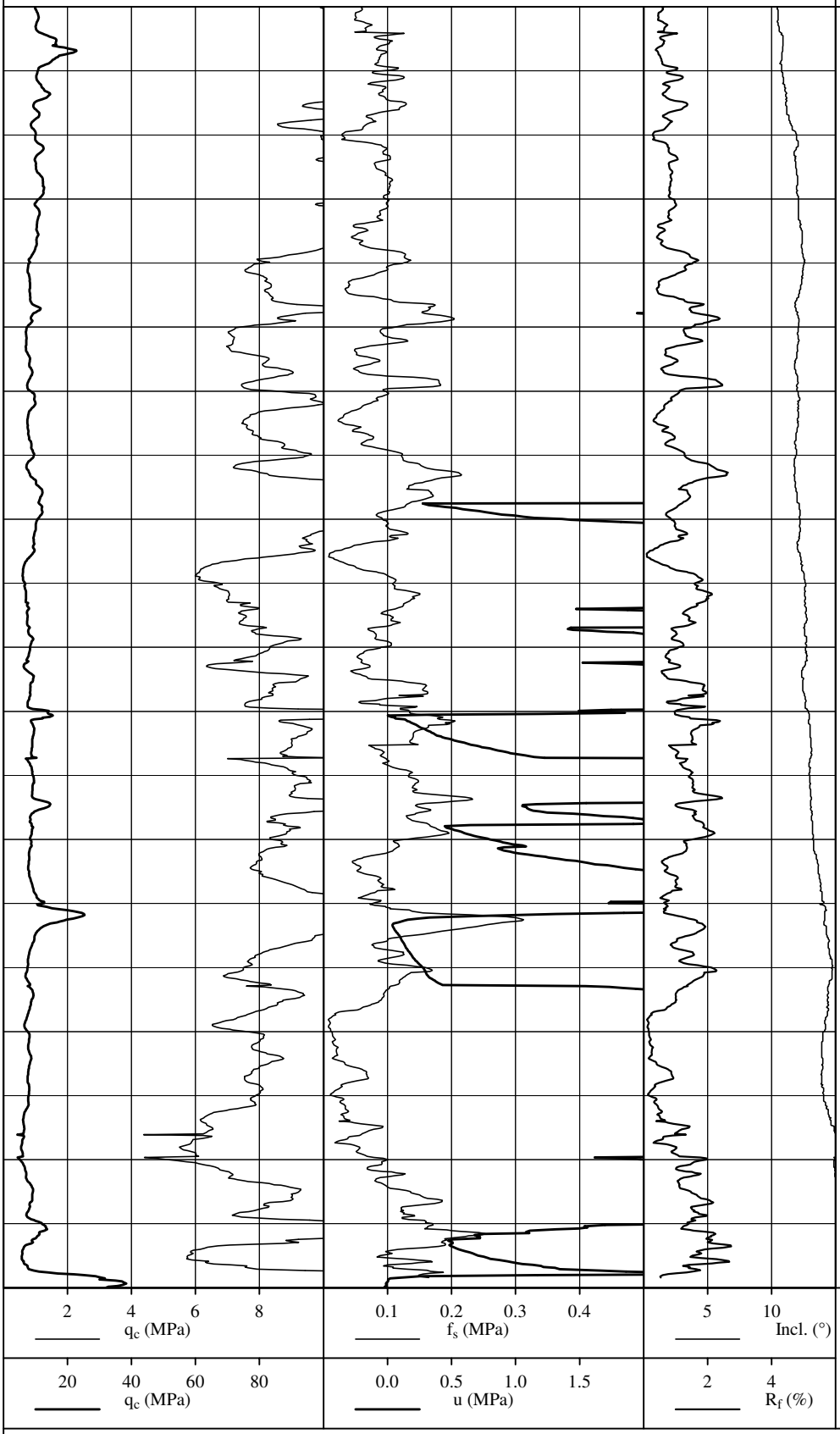
CPT name : ST14461-CPT8



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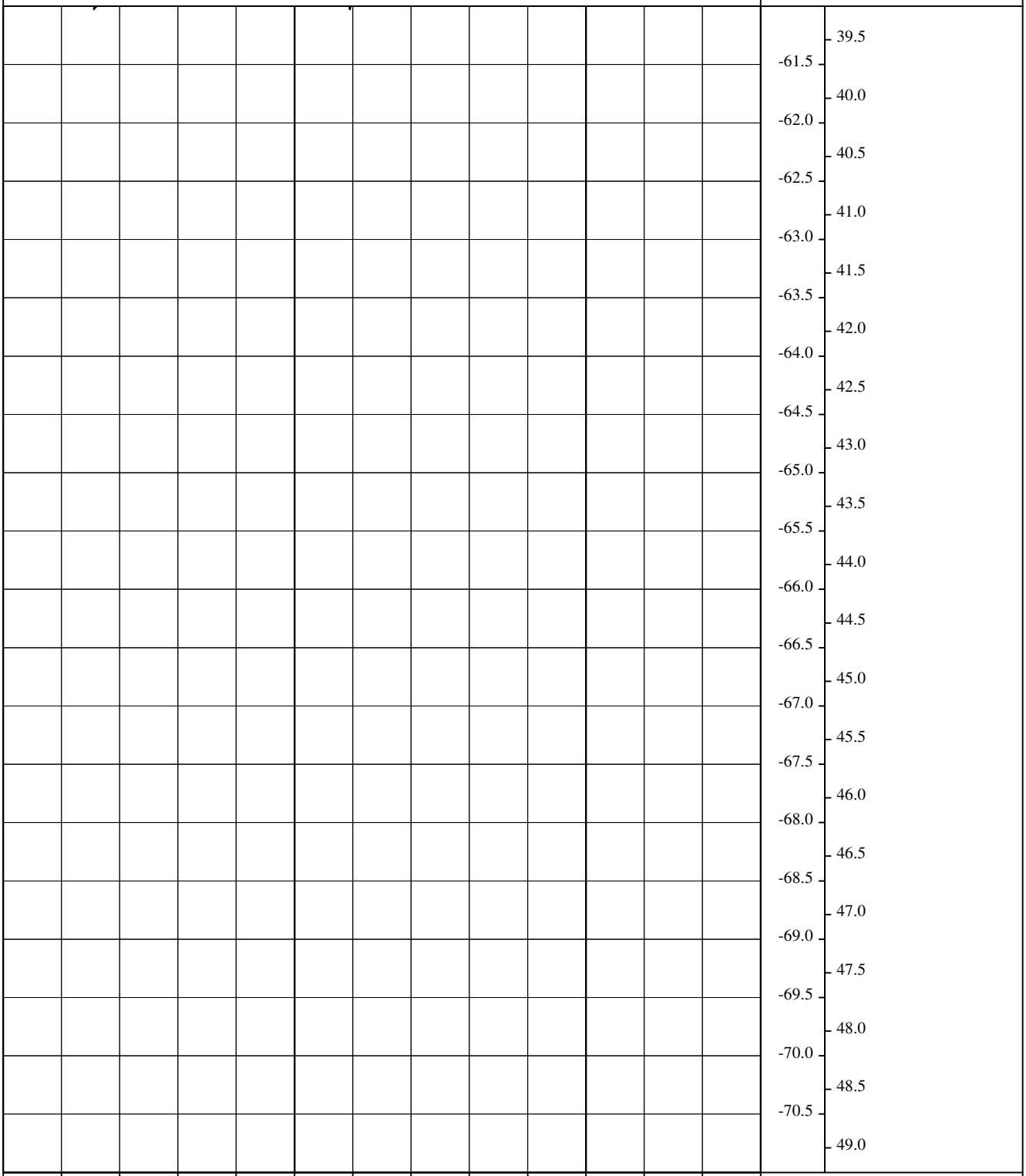
CPT name : ST14461-CPT8



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System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

GEO Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT8	
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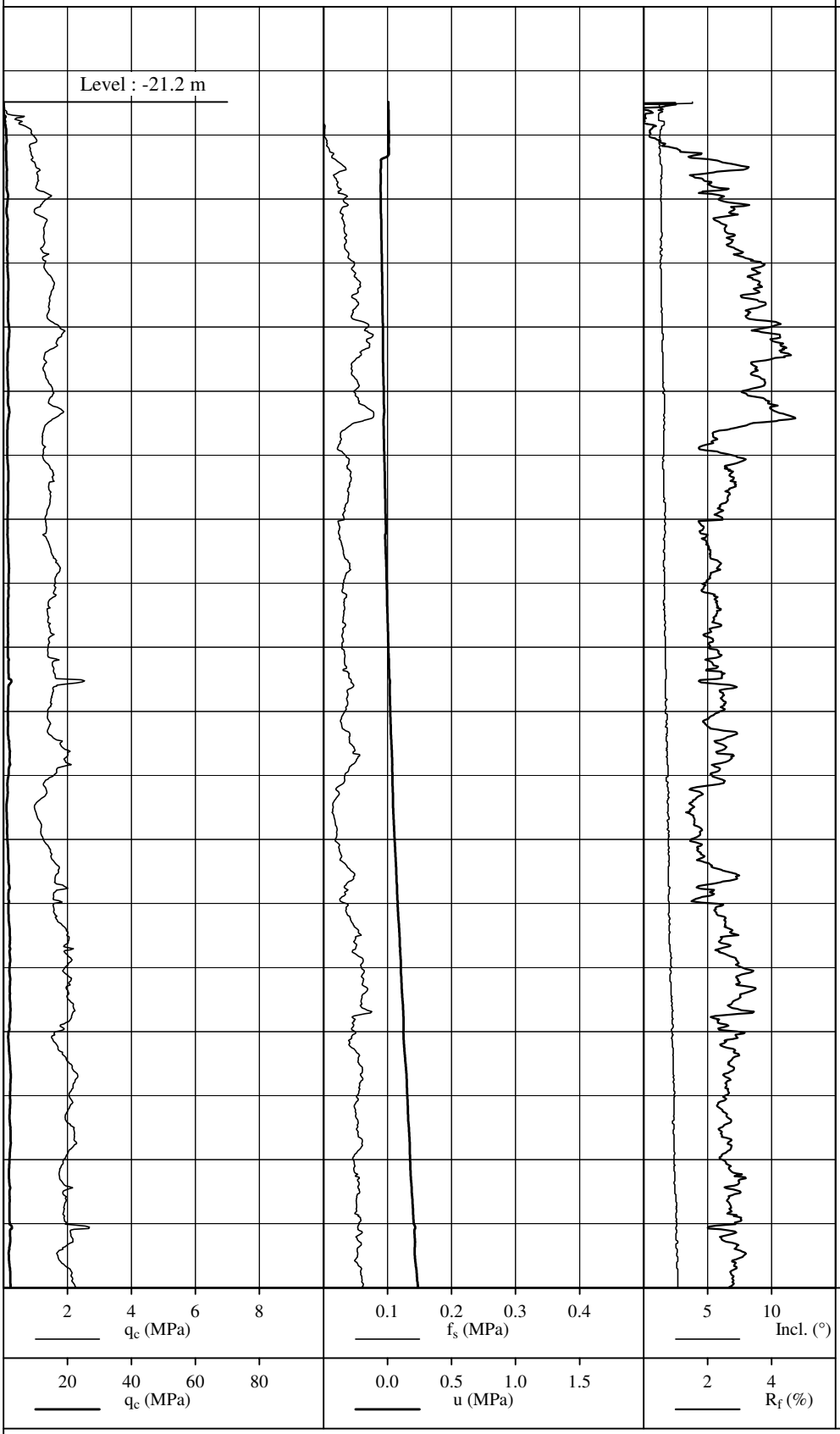
Approved	:	Date: 2014-03-13	Report Enclosure: ST14461-CPT8	Rev.

Perceptor - 1.5.10.102

Printed 2014-03-13 16:18:48

CPT name : ST14461-CPT9



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System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT9		
Checked	:	Date: 2014-03-13			Page 1 / 2
Approved	:	Date: 2014-03-13	Report	Enclosure: ST14461-CPT9	Rev.

Perceptor - 1.5.10.102

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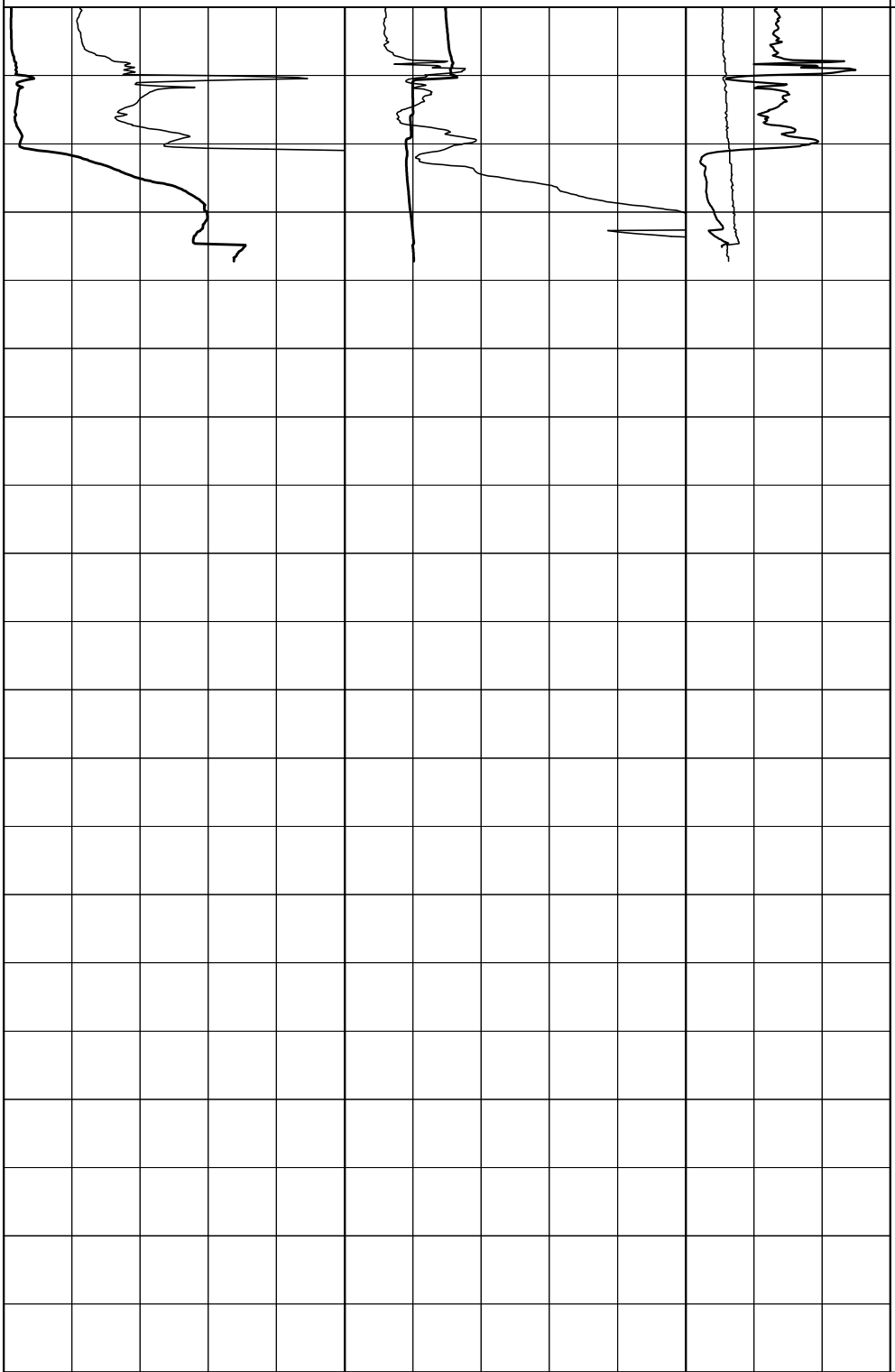
CPT name : ST14461-CPT9



E	: 389845.0	Cone no.	: 130811	Rig	: GEOScope
N	: 5901183.0	Cone type	: TSP	Performed by	: BVI/2014-03-13
System	: UTM 31/WGS 84	Cone area	: 10.0 cm^2	Remark	:

Danish Geotechnical Institute — Project : 36685 Dudgeon

Prepared	: ABP	Date: 2014-03-13	Subject: ST14461-CPT9		
Checked	:	Date: 2014-03-13			Page 2 / 2
Approved	:	Date: 2014-03-13	Report	Enclosure: ST14461-CPT9	Rev.

Perceptor - 1.5.10.102

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9 APPENDIX 3: GEOARCHAEOLOGICAL RECORDING

BH02

Depth mbSB		Description. (b) - bagged sample (c) - core sample
from	to	
	11.30	(b) 10YR 3/3 Dark brown on outside 10YR 3/1 very dark grey inside. Gravelly sandy clay. Possibly peaty? Just about mouldable. Sand fine to medium grained. Some small pebbles up to 12mm angular. Possible coal - hard organic material. Occasiona red flint pebbles. Frequent shell fragments. Occasional plant remains including rounded material with fibres.
13.30	13.80	(b) 10YR 5/4 Yellowy brown. Clayey sandy gravel. Sand fine to coarse. Gravel - pebbles up to 25mm visible, very shelly. Various marine molluscs. No structure discernible. Lump of gravelly sandy silty clay visible, 75mm in diameter - 2.5Y 6/1 - light grey. Frequent chalk pebble inclusions.
	13.80	(b) 2.5Y 6/1 Grey. Shelly gravelly sandy silty clay. Very light silty clay with frequent white and dark inclusions. Possibly chalk and organic fragments. Sand fine to medium - brown surrounding the light clay. Difficult to tell internal structure from the bag. Large pebble or cobble possibly flint approx. 30mm. Possible shell fragments.
15.35	15.42	(b) 2.5Y 6/1 Grey. Soft sandy silty clay with frequent white chalk inclusions up to 12mm diameter. Black subangular inclusions up to 4mm diameter visible. Large, black organic inclusion on the outside of the core .

BH03

Depth mbSB		Description. (b) - bagged sample (c) - core sample
from	to	
	1.40	(b) 10YR 4/3 Brown. Shelly gravelly silty sand. Sand - fine to coarse. Gravel - small pebbles up to 13mm diameterincluding flints and other sedimentary rock. Shells - fragments though no whole pieces visible. Well sorted - though difficult to tell whether structure damaged in the bag.
	2.20	(b) 10YR 5/3 - 2.5Y 5/3 Greyish brown. Gravelly shelly silty sand. Sand fine to very coarse. Gravels - granule sup to 3mm visible. Well sorted though structure seems broken in bag. Shell fragments though none whole, visible up to 4mm. Marine molluscs.
2.65	2.85	(c) 2.5Y 3/2 Very dark grey brown. Wet. Horizontally layered. Gravelly sandy peaty silty clay with layers of peat at 2.65 - 2.71 and 2.76 - 2.79m. Frequent shell inclusions up to 14mm diameter- marine molluscs. Possible seed found at 2.75m. Possible "burrowing" at 2.68, 2.73 and 2.80m.
	3--4	(b) 10YR 4/2 - 4/1 Seems to be banded in terms of colour. Slightly gravelly shelly silty clay sand with bands of sandy silty clay? Difficult to define structure in the bag. Sand fine to coarse and granules up to 4mm. Frequent shell fragments. Looks to have a clay centre.

BH04

Depth mbSB		Description. (b) - bagged sample (c) - core sample
from	to	
13.20		(b) 2.5Y 4/2 Dark greyish brown. Dark grey 2.5Y 4/1 in centre. Wet, very soft, slightly silty gravelly, shelly sand. Sand very fine. Gravels - granules to pebbles up to 18mm in diameter - subangular. Shells - marine molluscs - including cockle up to 20mm diameter.

BH06

Depth mbSB		Description. (b) - bagged sample (c) - core sample
from	to	
2.35		(b) 10YR 3/2 grey/brown on outside. 2.5Y 2.5/1 dark grey/nearly black in middle. Very silty very fine sand. Quite wet. Frequent granular inclusions.
3.00	4.00	(c) 2.5Y 5/2 greyish brown. Gravelly sand (medium to coarse grained). Gravel is mostly flint subrounded to angular up to 15mm in diameter. Very frequent marine molluscs (broken and whole). Particularly from 3.2 to 3.46. Includes oyster, cockle and winkle. Slightly sorted with horizontal beds of broken shell. Whole netted dog whelk at 3.30m. At 3.48 slightly silty below shell bed. Uniform to the end and a darker greyer shade - possibly due to drying.
9.00	10.00	(c) 2.5Y 4/1 dark grey. Uniform sand. Medium to very coarse grained. Includes occasional small flint rounded to angular up to 8mm in diameter. Frequent broken shell. Occasionally whole including a cockle at 9.14 and a bivalve at 9.54. Band of broken shell from 9.23 to 9.25. Sorted. Shallow marine deposits.
10.00	10.47	(c) 10.00-10.22 2.5Y 4/1 Dark Grey. Slightly silty gravelly sand. Wet. Sand fine to coarse with frequent granules to pebbles of chalk and flint up to 4mm visible. Gravels predominantly shell fragments which are larger and more frequent between 10.20 and 10.22. Marine molluscs. 10.22 - 10.47 - Layers of horizontally bedded gravelly sandy peaty silty clay and sandy silty clay. 10.22 - 10.29 2.5Y 3/2 Very dark greyish brown. Peaty gravelly sandy silty clay/ clay sand. Gravels are granules and shell fragments. Cockles and whole hydrophia 4mm brown at 10.27m. 10.29 -10.36 2.5Y 4/2 Dark greyish brown. Layers of sandy silty clay with peaty inclusions. Also layers of more sandy deposit. 10.36 - 10.47 2.5Y 3/2 Very dark grey brown. Visibly darker than above layer. Layers of sandy silty clay. Occasional whole marine molluscs - possible burrows from marine deposit? 10.33-10.36, 10.36-10.37, 10.39 - 10.40 and 10.42 - 10.43.
10.52	10.61	(b) 10YR 2/2 very dark brown/black peat. Occasional fine sand. Occasional broken cockle fragments up to 12mm in diameter. Broken fragments in a bag - compacted.
10.61	10.66	(b) 10YR 2/2 Very dark brown. Fragmented peat. Stiff/compacted. Occasional fine to medium sand, possible tiny shell fragments.
10.66	10.72	(b) 10YR 2/2 Very dark brown/ almost black. Very stiff peat. Compacted but slightly broken core sample. Seems horizontally bedded. Occasional fine sand. Small areas of mould growth indicate organic matter.
11.10		(b) 10YR 2/2 Very dark brown with 10YR 3/3 more brown edges. Silty sand and peat. Sand is fine grained. Outer coating of 2.5Y 4/1 dark grey medium grained sandon the outside. Broken up lump.

11.40		(b) 10YR 2/2 Very dark brown/ almost black. Fragmented core sample of peaty sandy silt. Occasional fine to medium sand. Seems horizontally bedded.
11.50	11.70	(c) 10YR 2/2 Very dark brown. Seems to get darker at 11.69, possibly due to storage. Stiff peat with very occasional fine sand. Some plant remains. Very dry/crumbly. Some horizontal bedding.
12.00	12.56	(c) 2.5Y 3/2 Dark greyish brown. 12.00 - 12.04 Soft sandy silty peat. Sand fine to medium. 12.04 - 12.08 2.5Y 4/1 Dark grey. Wet silty sand. 12.08 - 12.16 2.5Y 3/2 Dark greyish brown sandy silty peat - sand fine to medium. Occasional shell inclusions with darker patches of organic material. 12.16 - 12.38 2.5Y 3/2 Very dark grey brown. Stiff. Horizontal layers of peat and sandy peaty silty clay with 2.5Y 2.5/1 Black peat. Organic smell present. Occasional shell fragments. 12.38 - 12.56 2.5Y 4/2 Dark grey brown. Sandy peaty silty clay layered with 2.5Y 2.5/1 Black peat. Occasional shell fragments and organic smell.
12.60	12.71	(b) 10YR 2/2 Very dark brown. Wet intact core sample. Surrounded by dark greyish brown sandy clay. Wet sandy silt. Maybe peat? Possibly banded in bedding? Occasional fine sand. Broken shell fragment visible (cockle) 9mm in diameter.
12.71	12.76	(b) 10YR 2/2 Very dark brown/ almost black. Wet. Peaty Sandy silt. Very fine sand with some medium inclusions. Occasional white inclusions - possibly shell.
12.76	12.82	(b) 10YR 2/2 Very dark brown/ almost black. Wet sandy silt/silty sand. Sand very fine. Slightly darker on the inside. Frequent shell fragments up to 9mm, possibly oyster and cockle. Occasional whole gastropods molluscs up to 4mm in length.
13.10	13.15	(b) 2.5Y 4/2 dark greenish grey brown / 5Y 3/2.Soft very slightly clayey sandy silt. Sand predominately fine grained. Possible inclusions of organic matter/ very dark brown. Impossible to determine structure from this sample.
13.15	13.25	(b) 2.5Y 4/2 Very dark greenish grey brown/ 5Y 3/2. . Soft slighty clayey silty sand /sandy silt. Fragmented sample so no clear structure Very crumbly but can be moulded so clay may be present. Sand predominately fine. Occasional small chalk and flint pebble inclusions up to 11mm in diameter.
13.25	13.30	(b) 2.5Y 4/3 Very dark greenish grey brown. 2.5Y 4/1 dark grey in centre, possibly dried on the outside. Darker patches of possibe degraded organic material. Intact core sample. Silty clay sand/ very sandy clay - clay in bands. Sand is predominantly fine grained. Some small pebble inclusions Including flint and chalk up to 14mm diameter.
13.30		(b) 2.5Y 4/1 dark grey - brown on outside. Soft silty clayey sand. Some layering present. Layers of darker possibly organic material.
13.65	13.68	(b) 7.5YR 4/3 or 10YR 4/3 brown. Possibly oxidised in bag. Sandy silty clay or silty clay sand. Sand predominantly fine. Some larger grains to granule inclusions. Infrequent small pebbles 4mm.Sample completely fragmented.
14.00	14.??	(b) 2.5Y 4/1 dark grey - brown on outside - possibly oxidised. Very soft sandy silt on inside - some darker organic inclusions. More sandy on outside. Sand predominantly fine but occasional medium to coarse. Occasional small pebble inclusions up to 10mm visible including flint. No determinable structure but may alternate in brown sand and grey silt. Broken up core into 3 separate lumps.

14.39	14.44	(b) 10YR 4/3 Brown. Wet, soft, silty sand. Predominantly fine grained. Occasional medium to larger grained. Frequent black possibly organic flecks - organic matter. Occasional small flint pebbles up to 3mm diameter.
14.44	14.79	(b) 10YR 4/3 Brown. Wet and occasioanlly layered silty sand/sandy silt (grey) with darker patches. Layer of medium to coarse sand. Possible broken shell inclusions up to 4mm diameter. Occasional organic fragments.
14.79	14.85	(b) 10YR 4/3 Brown with 2.5Y 4/1 dark grey at centre. oxidised sandy silty clay /silty clayey sand. Sand is predominantly fine grained. Occasional fragments of flint/shell.
15.30		(b) 10YR 4/3 outside 2.5Y 4/1 Dark grey at centre oxidised wet gravelly silty clayey sand. Sand predominantly fine grained. Gravel includes chalk and flint up to 9mm diameter. Occasional small probably broken shell fragments.
19.20	19.23	(b) 10YR 4/3 Brown. Loose wet silty gravelly sand. Sand is medium to very coarse grained. Gravel is up to 17mm diameter including flint and chalk. Very dark flecks of organic material.

BH13

Depth mbSB		
from	**to**	**Description. (b) - bagged sample (c) - core sample**
11.00		(b) 10YR 4/4 Wet slightly silty sand. Sand is predominantly fine grained. Frequent shell inclusions up to 7mm diameter. No visible larger inclusions.

BH15

Depth mbSB		
from	**to**	**Description. (b) - bagged sample (c) - core sample**
8.40	8.50	(b) 10YR 5/4 - 5/5. Wet, gravelly, shelly, slightly silty sand. Sand is predominantly fine grained. Layering visible. Shell fragments up to 14mm diameter. Marine molluscs. Pebbles including flint up to 15mm diameter. Subangular to subrounded.

BH19A

Depth mbSB		
from	**to**	**Description. (b) - bagged sample (c) - core sample**
0.35		(b) 10YR 4/2 Dark greyish brown /10YR 4/4. Shelley gravelly sandy silty clay. Very soft - mouldable. Sandy layers are lighter. Some sorting and layering visible. Sand is predominantly fine grained. Some granules visible. Gravels up to pebbles at 32mmm subrounded. Molluscs up to 10mm diameter including marine bivalves

BH21

Depth mbSB		Description. (b) - bagged sample (c) - core sample
from	to	
0.00	1.00	(b) 10YR 5/2 Greyish brown. Slightly silty sandy shelly gravel. Shells of various types including cockle/oyster/whelk. Gravel includes large cobbles up to 90mm diameter. Sand fine to coarse.
0.70	0.90	(c) 10YR 4/1 Dark grey - dark grey brown very soft - soft sandy silty clay. Sand fine to medium. Black granular inclusions. Sand and clay seems horizontally layered though core hasn't been opened. Sand visible at 0.7m but not at 0.9m.
1.90	1.98	(c) 2.5Y 4/1 Dark grey with brownish/green tinge. Sandy slightly clayey silt. Slightly sulphurous odour noticeable. Looks uniform. Sand fine with occasional coarser granules. Hole in centre 1.93 - 1.945 - both sides.
2.00	2.23	(c) 10YR 4/3 Greyish brown from 2.00 to 2.15. Horizontally bedded layers of soft gravelly sandy silty clay and gravelly silt clay sand. Sand fine to coarse. Gravel granules to small pebbles but predominantly shell fragments. 10YR 3/3 Dark greyish brown from 2.15 to 2.23. Layers of gravelly sandy silty clay? Gravels predominantly cockle shells and hydrobia.
2.10	2.24	(b) 2.5Y 3/1 Very dark grey. Silty gravelly sand. Sand predominantly fine. Gravels very coarse sand to pebbles up to 18mm including flint, chalk and possible shell fragments.
2.22	2.38	(b) 10YR 2/1 Very dark brown mixed sandy shelly slightly organic silt. Some layering. Sand light tan colour 10YR 6/6. Predominantly fine grained. Shells include marine molluscs - mostly cockles up to 25mm diameter. Occasional gastropods up to 3mm in length. Large clusters of molluscs in areas. Dry, intact core, broken in two
2.26	2.43	(b) 2.5Y 3/2 Very dark greyish brown gravelly peaty silty sand / sandy silt. Sand is predominantly fine grained. Gravel up to 12mm diameter.
3.10		(b) 10YR 2/1 Very dark brown gravelly slightly organic shelly sandy silt. Gravel up to 4mm diameter. Shell fragments up to 6mm diameter Including marine molluscs - cockle.
5.00	5.48	(c) 5.0 - 5.04 2.5Y 5/2 greyish brown silty sand. Sand predominantly fine. 5.04 - 5.05 2.5Y 5/2 Greyish brown. Gravelly sandy silty clay. Gravel is angular up to 4mm diameter. 5.05 - 5.08 2.5Y 5/2 Silty clay sandy gravel. Gravels up to 10mm diameter including shell fragments. 5.08 - 5.30 2.5Y 5/2-4/2 Horizontally bedded silty clay sand with bands of sandy silty clay. Sand very fine. 5.28 - 5.29 and 5.31 - 5.32 bands of lighter fine wet sand. 5.30 - 5.48 2.5Y 3/2 Dark greyish brown sandy silty clay. Sand very fine. Occasional bands of darker sediment. Occasional gravel and shell inclusions.
5.47	5.52	(b) 10YR 4/2 Greyish brown silty clayey sand. Sand fine to very coarse grained up to up to 2mm diameter. Occasional black flecks up to 4mm diameter
5.52	5.68	(b) 10YR 4/2 Greyish brown. Sandy clayey silt / clayey silty sand. Wet. Sand fine to large. Occasional gravel including flint/chalk up to 6mm diameter.
5.72	5.80	(b) 10YR 4/2 Greyish brown slightly sandy silty clay. Soft. Sand very fine. Occasional coarser inclusions.

6.00	6.28	(c) 6.00 - 6.06 2.5Y 5/3 yellowish brown wet slightly silty sand. Sand very fine to fine. Some coarser inclusions. 6.06-6.11 10Yr 4/2 Greyish brown very soft slightly sandy silty clay. 6.11 - 6.15 2.5Y 4/2 Greyish brown slightly silty sand with chalk inclusions up to 5mm visible. 6.15 - 6.18 10YR 4/2 slightly sandy very soft silty clay. 6.18 - 6.28 2.5Y 4/2 Horizontally bedded wet slightly silty sand with bands of more clayey layers visible.
6.27	6.45	(b) 10YR 4/2 Greyish brown soft sandy silty clay. Sand very fine grained. Occasional gravel including, shell and chalk.
6.51	6.67	(b) 10YR 4/4 - 4/3 Yellowish grey brown. Mixture of sandy silty clay and silty clay sand. Sand fine to occasional granules.
6.63	6.70	(b) 10YR 4/3 - 4/4 Alternating layers of sand and silty clay sand and sandy silty clay. Sand fine with occasional coarser inclusions. Fragmented.
9.73	9.78	(b) 10YR 4/3 - 4/4 Mixture of silty clay sand / sandy silty clay. Sand fine with occasional coarser inclusions.
9.73	9.78	(2) (b) 10YR 4/4 Seems fairly intact. Wet. Slightly clay silty sand. Sand fine with frequent black granules. Occasional white granules - possible chalk.
9.84	9.90	(b) 10YR 4/2 - 4/3 Greyish brown. Soft slightly silty clay sand. No visible structure. Sand is fine grained. Fragmented.
10.00	10.83	(c) 10YR 4/3 - 10YR 4/2 Brown. Layers of sandy silty clay and silty clay, horizontally bedded. Frequent thin layers of fine sand throughout deposit. More frequent between 10.05 - 10.10, 10.30 - 10.33 and 10.72 - 10.83.
10.84	10.90	(b) 10YR 4/2 - 4/3 Greyish brown sandy silty clay. Sand is fine grained with occasional coarser inclusions. Fragmented.
11.70	11.75	(b) 10YR 4/2 - 4/3 Greyish brown soft slightly sandy silty clay. Sand is fine to occasionally coarse grained. Fragmented and dried.

BH25

Depth mbSB		
from	**to**	**Description. (b) - bagged sample (c) - core sample**
2.60	2.80	(c) 7.5YR 4/2 Brown soft sandy silty clay . Some horizontal bedding visible. Sand fine to coarse grained. Frequent granular chalk inclusions. Small pebbles up to 20mm diameter found between 2.64 - 2.66.
7.50	7.68	(c) 10YR 4/3 Brown stiff sandy silty clay. Sand is predominantly fine grained. Occasional chalk inclusions. Limestone pebble 12mm diameter at 7.62m and flint 28mm diameter at 7.58m.
12.50	12.65	(c) 10YR 4/3 Brown. Stiff sandy silty clay. Sand is very fine grained. Frequent inclusions of chalk up to 12mm diameter. One large pebble, 30mmx21mm, horizontally bedded found at 12.60. Horizontal bedding of sandy clay, clay sand.

10 APPENDIX 4: MICROFAUNA (FORAMINIFERA AND OSTRACODS)

Borehole BH06

ORGANIC REMAINS

Depth below seabed	*2.35m*	*10.29m*	*10.45m*	*11.72m*	*12.00m*	*12.15m*	*12.39m*	*12.53m*	*12.76m*	*13.25m*	*14.00m*
Depth below LAT	22.45m	30.39m	30.55m	31.82m	32.10m	32.25m	32.49m	32.63m	32.86m	33.35m	34.10m
plant debris + seeds + megaspores	x	x	x	x	x	x	x	x	x	x	x
charcoal	x									x	x
molluscs	x	x	x	f	x	x	f	x	x		
brackish foraminifera	x	x	x	x	x	x			x		
brackish ostracods	x	x	x		x	x			x		
outer estuarine/marine foraminifera	x	x		x	x	x			x		
outer estuarine/marine ostracods	x	x									
fish remains		x	x	x	x	x	x				
insect remains		x	x			x	x	x	x		
freshwater ostracods					x	x	x	x	x		
charophyte oogonia							x				
Cretaceous microfossils (reworked)										x	x

Ecology	*Open estuary with established brackish and marine influences*	*Freshwater component suggests some cold/deep water. Brackish/marine component perhaps washed in initially and latterly, until it becomes an estuary*	*Fluviatile; ?high energy*

BRACKISH FORAMINIFERA

Depth below seabed	*2.35m*	*10.29m*	*10.45m*	*11.72m*	*12.00m*	*12.15m*	*12.39m*	*12.53m*	*12.76m*	*13.25m*	*14.00m*
Depth below LAT	22.45m	30.39m	30.55m	31.82m	32.10m	32.25m	32.49m	32.63m	32.86m	33.35m	34.10m
Ammonia sp. (brackish)	xxx	xxx	xxx	o	x	x					
Elphidum williamsoni	xx	x	xxx	x		o			o		
Haynesina germanica	xx	x	xx								
Elphidium waddense			x								

Calcareous foraminifera of low-mid saltmarsh and tidal flats

OUTER ESTUARINE/MARINE FORAMINIFERA

Depth below seabed	*2.35m*	*10.29m*	*10.45m*	*11.72m*	*12.00m*	*12.15m*	*12.39m*	*12.53m*	*12.76m*	*13.25m*	*14.00m*
Depth below LAT	22.45m	30.39m	30.55m	31.82m	32.10m	32.25m	32.49m	32.63m	32.86m	33.35m	34.10m
miliolids	xx	xxx		x	x	x					
Ammonia batavus	xx	x		x	xxx	o			xx		
Elphidium macellum	x	xx							x		

Essentially marine foraminifera, but can penetrate outer estuaries

BRACKISH OSTRACODS

Depth below seabed	2.35m	10.29m	10.45m	11.72m	12.00m	12.15m	12.39m	12.53m	12.76m	13.25m	14.00m
Depth below LAT	*22.45m*	*30.39m*	*30.55m*	*31.82m*	*32.10m*	*32.25m*	*32.49m*	*32.63m*	*32.86m*	*33.35m*	*34.10m*
Cyprideis torosa (smooth)	xx	x	xxx		o				o		
Loxoconcha elliptica	x	xx	xx			o			x		
Leptocythere castanea	x	x									
Xestoleberis nitida	o	xx	x								
Cytherois fischeri		x									
Cytherura gibba		o	x								

Brackish ostracods of tidal flats and creeks

OUTER ESTUARINE/MARINE OSTRACODS

Depth below seabed	*2.35m*	*10.29m*	*10.45m*	*11.72m*	*12.00m*	*12.15m*	*12.39m*	*12.53m*	*12.76m*	*13.25m*	*14.00m*
Depth below LAT	22.45m	30.39m	30.55m	31.82m	32.10m	32.25m	32.49m	32.63m	32.86m	33.35m	34.10m
Hirschmannia viridis	xx	xx									
Hemicythere villosa	xx	xx									
Leptocythere pellucida	xx	x									
Semicytherura nigrescens	x	xx									
Loxoconcha rhomboidea	x										
Heterocythereis albomaculata	x										
Cythere lutea	o										
Semicytherura sella		o									

Essentially marine ostracods, but can penetrate outer estuaries

FRESHWATER OSTRACODS

Depth below seabed	*2.35m*	*10.29m*	*10.45m*	*11.72m*	*12.00m*	*12.15m*	*12.39m*	*12.53m*	*12.76m*	*13.25m*	*14.00m*
Depth below LAT	22.45m	30.39m	30.55m	31.82m	32.10m	32.25m	32.49m	32.63m	32.86m	33.35m	34.10m
Cytherissa lacustris					x	xx	x	xxx	xx		
Candona neglecta					o	x	x	xxx	o		
Cyclocypris ovum						xx	o	x			
Candona candida						x					
Ilyocypris sp.								xx			
Herpetocypris reptans								xx			
Potamocypris zschokkei								x			

Freshwater ostracods of tidal rivers, pools and lakes

Organic remains are recorded on a presence (x)/absence basis only; f – fragments only
Foraminifera and ostracods are recorded: o - one specimen; x - several specimens; xx - common; xxx - abundant/superabundant

LAT – Lowest Astronomical Tide

Borehole BH21

ORGANIC REMAINS

Depth below seabed	*0.70m*	*1.97m*	*2.21m*	*3.10m*	*5.11m*	*10.81m*
Depth below LAT	19.80m	21.07m	21.31m	22.20m	24.21m	29.91m
plant debris + seeds	x	x	x	x		
molluscs	x	x	x	x	f	
brackish foraminifera	x	x	x	x		
brackish ostracods	x	x	x	x		
outer estuarine/marine foraminifera	x	x		x	x	x
outer estuarine/marine ostracods	x	x	x	x		
?charcoal					x	x
Cretaceous microfossils (reworked)					x	x

Ecology	*Seagrass/algal*	*Mudflats and creeks;*	*Marine; ?reworked*

BRACKISH FORAMINIFERA

Depth below seabed	*0.70m*	*1.97m*	*2.21m*	*3.10m*	*5.11m*	*10.81m*
Depth below LAT	19.80m	21.07m	21.31m	22.20m	24.21m	29.91m
Ammonia sp. (brackish)	xxx	xxx	xxx	xxx		
Haynesina germanica	x		xx	x		
Elphidium williamsoni			xxx	x		

Calcareous foraminifera of low-mid saltmarsh and tidal flats

OUTER ESTUARINE/MARINE FORAMINIFERA

Depth below seabed	*0.70m*	*1.97m*	*2.21m*	*3.10m*	*5.11m*	*10.81m*
Depth below LAT	19.80m	21.07m	21.31m	22.20m	24.21m	29.91m
miliolids	x	xxx		x	x	o
Ammonia batavus	x			x	x	
Elphidium macellum		xx				
lagenids						x
Elphidium excavatum					o	

Essentially marine foraminifera, but can penetrate outer estuaries

BRACKISH OSTRACODS

Depth below seabed	*0.70m*	*1.97m*	*2.21m*	*3.10m*	*5.11m*	*10.81m*
Depth below LAT	19.80m	21.07m	21.31m	22.20m	24.21m	29.91m
Xestoleberis nitida	xx	o	xxx	xx		
Leptocythere castanea	x					
Cytherois fischeri	x	o	x			
Loxoconcha elliptica			xxx	xx		
Cyprideis torosa			x(s)	x(n)		
Cytherura gibba				x		

Brackish ostracods of tidal flats and creeks

OUTER ESTUARINE/MARINE OSTRACODS

Depth below seabed	*0.70m*	*1.97m*	*2.21m*	*3.10m*	*5.11m*	*10.81m*
Depth below LAT	19.80m	21.07m	21.31m	22.20m	24.21m	29.91m
Semicytherura nigrescens	xx	xxx	x	o		
Hirschmannia viridis	x	x	x	x		
Hemicythere villosa	o	x				
Nannocythere pavo		x	x	x		

Essentially marine ostracods, but can penetrate outer estuaries

Cyprideis torosa - x(s) smooth valves = salinity >6‰; x(n) noded valves = salinity <6‰

Organic remains are recorded on a presence (x)/absence basis only; f – fragments only
Foraminifera and ostracods are recorded: o - one specimen; x - several specimens; xx - common; xxx - abundant/superabundant

LAT – Lowest Astronomical Tide

Borehole BH02

ORGANIC REMAINS

Depth below seabed	15.35m
Cretaceous microfossils (reworked)	x

11 APPENDIX 5: RADIOCARBON DATING

Scottish Universities Environmental Research Centre

Director: Professor R M Ellam

Rankine Avenue, Scottish Enterprise Technology Park,
East Kilbride, Glasgow G75 0QF, Scotland, UK
Tel: +44 (0)1355 223332 Fax: +44 (0)1355 229898 www.glasgow.ac.uk/suerc

RADIOCARBON DATING CERTIFICATE

07 April 2014

Laboratory Code	GU33573
Submitter	Sarah F. Wyles Wessex Archaeology Portway House Old Sarum Business Park Salisbury, SP4 6EB
Site Reference	Dudgeon Wind Farm North Sea
Context Reference	BH 06 14 metres ()
Sample Reference	69681_BH06_14
Material	waterlogged seed : Potamogeton
Result	Failed: insufficient carbon.

N.B. Any questions directed to the Radiocarbon Laboratory should quote the GU coding given above.

The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

Checked and signed off by :- E Dunbar Date :- 07/04/2014

Scottish Universities Environmental Research Centre

Director: Professor R M Ellam

Rankine Avenue, Scottish Enterprise Technology Park,
East Kilbride, Glasgow G75 0QF, Scotland, UK
Tel: +44 (0)1355 223332 Fax: +44 (0)1355 229898 www.glasgow.ac.uk/suerc

RADIOCARBON DATING CERTIFICATE

07 April 2014

Laboratory Code	SUERC-51293 (GU33574)
Submitter	Sarah F. Wyles Wessex Archaeology Portway House Old Sarum Business Park Salisbury, SP4 6EB
Site Reference	Dudgeon Wind Farm North Sea
Context Reference	BH 06 10.29 metres ()
Sample Reference	69681_BH06_10.29
Material	Marine shell : Littorina
$\delta^{13}C$ relative to VPDB	-3.9 ‰
Radiocarbon Age BP	8324 ± 32

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

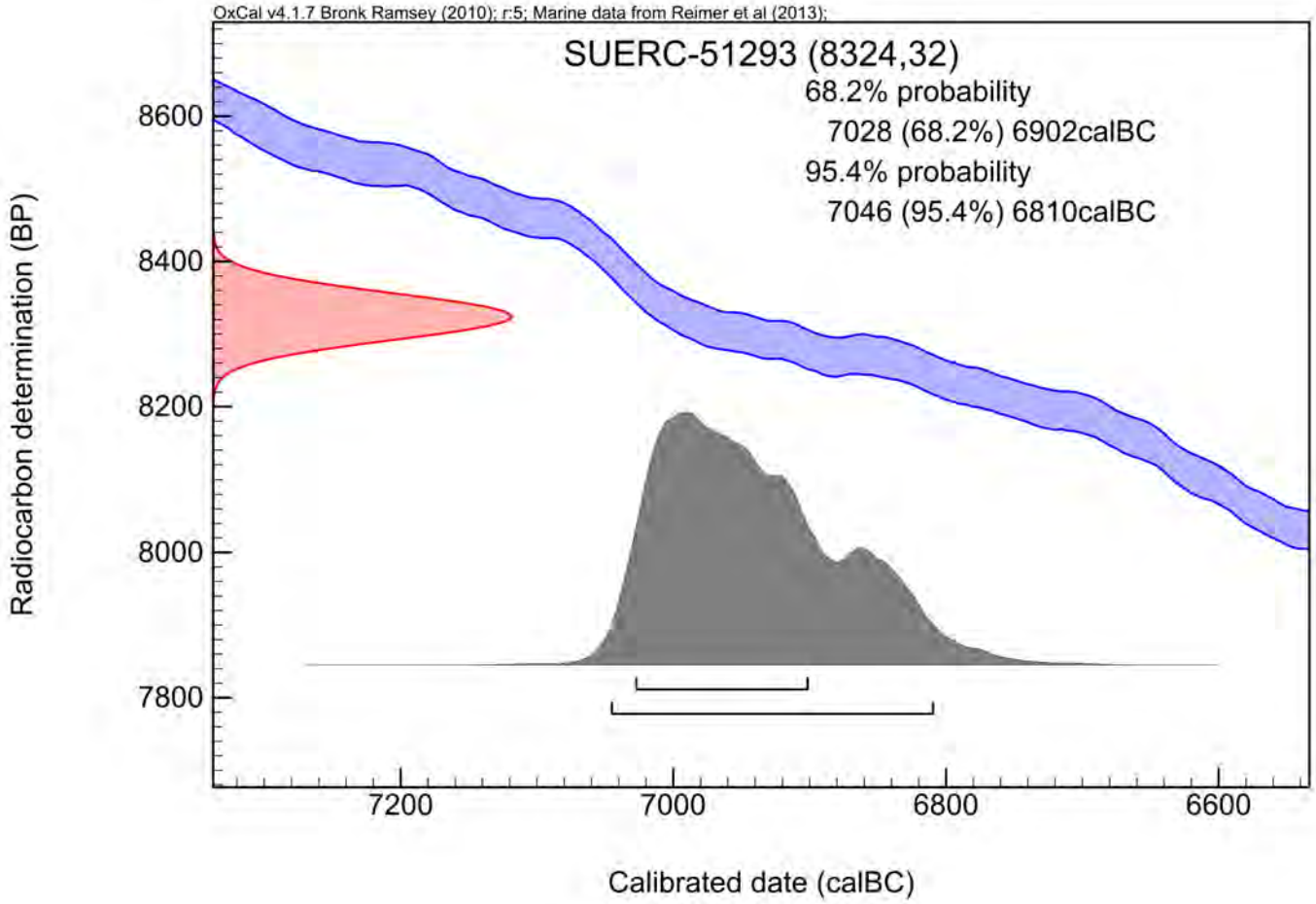
Conventional age and calibration age ranges calculated by :- N. Rudd Date :- 07/04/2014

Checked and signed off by :- E Dunbar Date :- 07/04/2014

University of Glasgow

THE UNIVERSITY OF EDINBURGH

Calibration Plot



Scottish Universities Environmental Research Centre

Director: Professor R M Ellam

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East Kilbride, Glasgow G75 0QF, Scotland, UK
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RADIOCARBON DATING CERTIFICATE

23 April 2014

Laboratory Code	SUERC-52113 (GU34111)
Submitter	Sarah F. Wyles Wessex Archaeology Portway House Old Sarum Business Park Salisbury, SP4 6EB
Site Reference	Dudgeon Wind Farm
Context Reference	BH 06 2.35 metres
Sample Reference	69681_BH06_2.35
Material	marine shell : Cerastoderma
$\delta^{13}C$ relative to VPDB	0.0 ‰ assumed
Radiocarbon Age BP	7549 ± 31

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

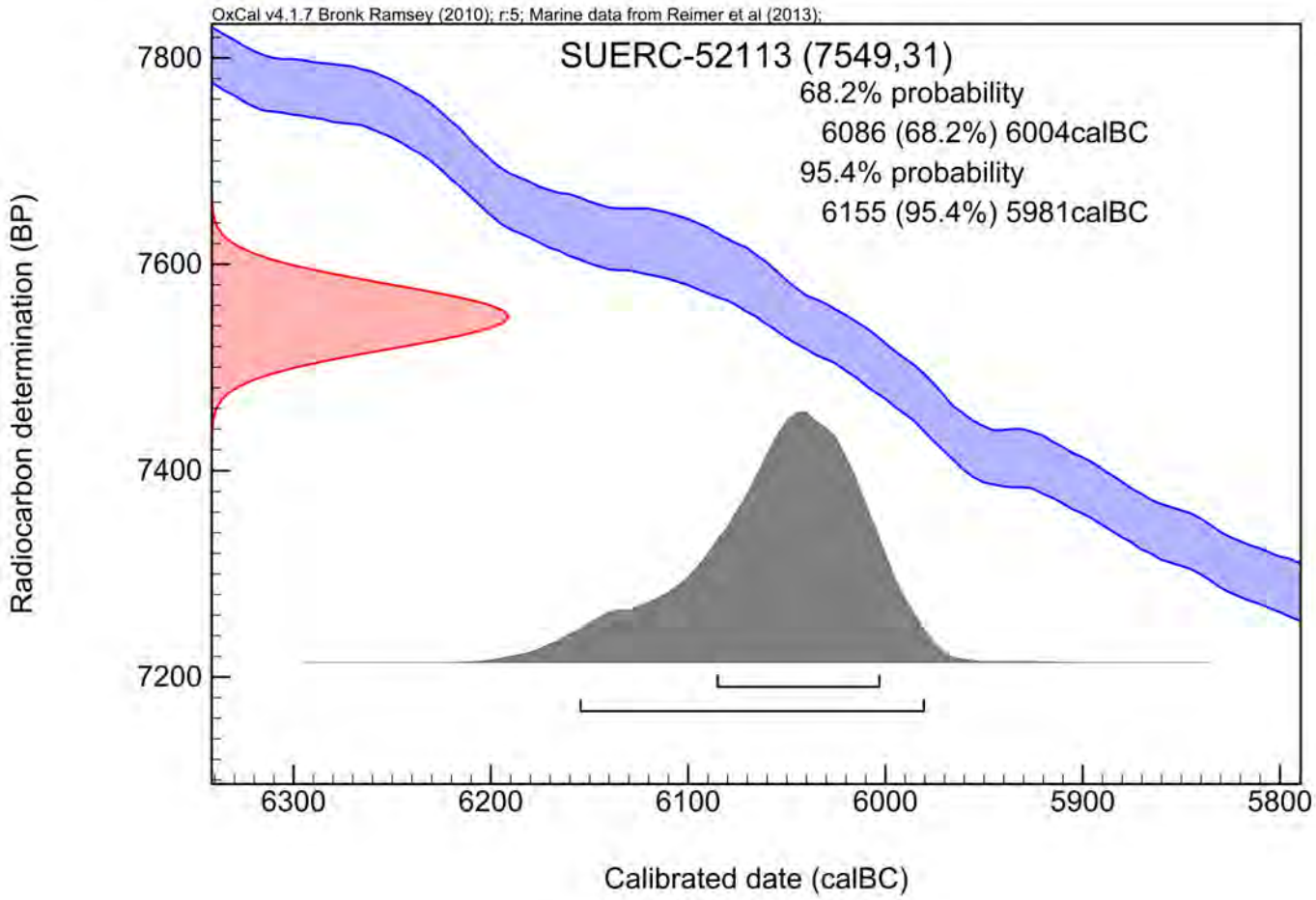
Conventional age and calibration age ranges calculated by :- N. Rudd Date :- 23/04/2014

Checked and signed off by :- P. Naysmith Date :- 23/04/2014

University of Glasgow

The University of Edinburgh

Calibration Plot



Scottish Universities Environmental Research Centre

Director: Professor R M Ellam

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RADIOCARBON DATING CERTIFICATE

07 April 2014

Laboratory Code	SUERC-51294 (GU33575)
Submitter	Sarah F. Wyles Wessex Archaeology Portway House Old Sarum Business Park Salisbury, SP4 6EB
Site Reference	Dudgeon Wind Farm North Sea
Context Reference	BH 21 3.10 metres ()
Sample Reference	69681_BH21_3.10
Material	Marine shell : Cerasoderma
$\delta^{13}C$ relative to VPDB	-9.9 ‰
Radiocarbon Age BP	8398 ± 32

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

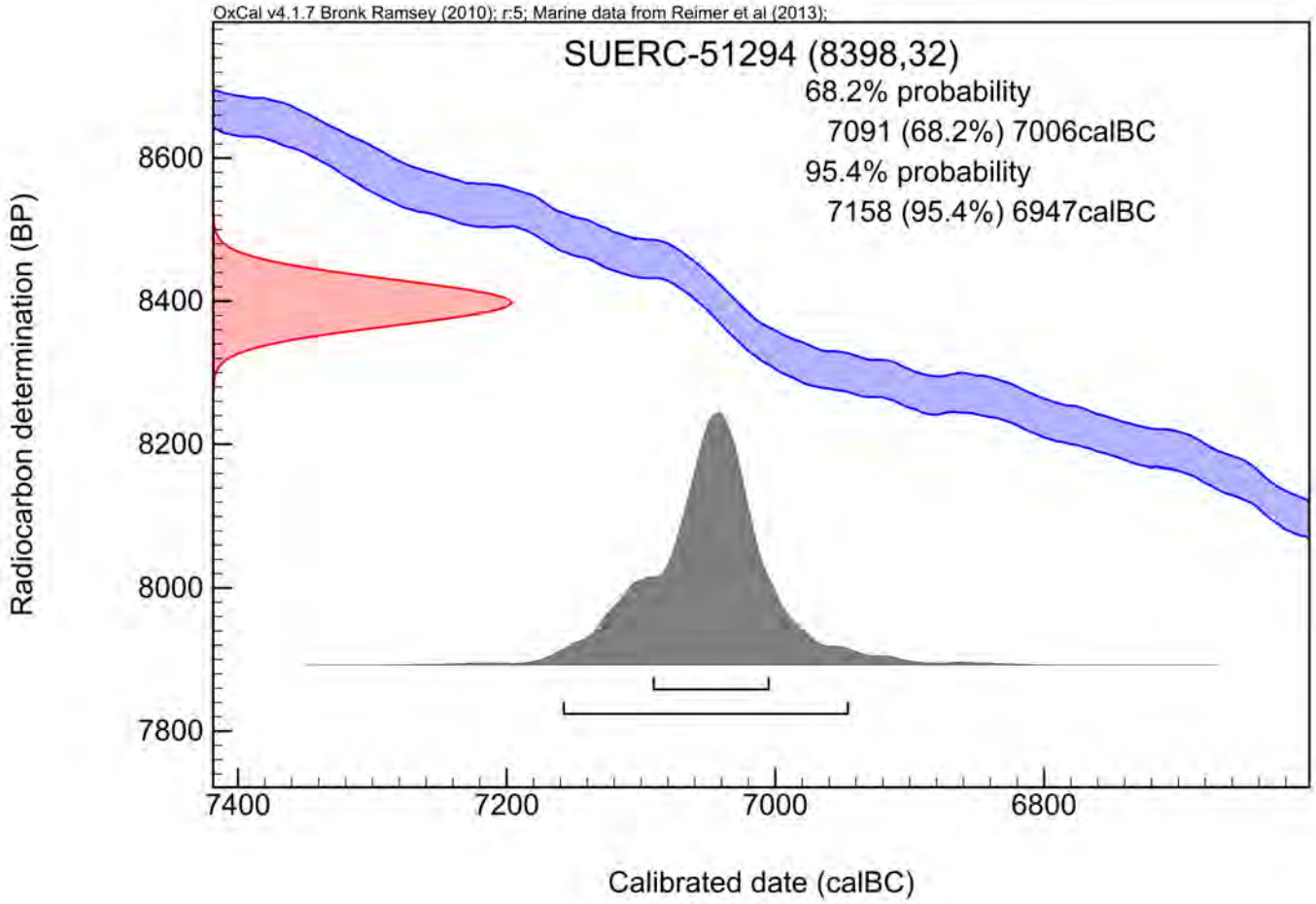
Conventional age and calibration age ranges calculated by :- N. Rudd Date :- 07/04/2014

Checked and signed off by :- E Dunbar Date :- 07/04/2014

University of Glasgow

THE UNIVERSITY OF EDINBURGH

Calibration Plot



Scottish Universities Environmental Research Centre

Director: Professor R M Ellam

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RADIOCARBON DATING CERTIFICATE

07 April 2014

Laboratory Code	SUERC-51295 (GU33576)
Submitter	Sarah F. Wyles Wessex Archaeology Portway House Old Sarum Business Park Salisbury, SP4 6EB
Site Reference	Dudgeon Wind Farm North Sea
Context Reference	BH 21 2.21 metres ()
Sample Reference	69681_BH21_2.21
Material	Marine shell : Cerasoderma
$\delta^{13}C$ relative to VPDB	-6.4 ‰
Radiocarbon Age BP	8295 ± 32

N.B. The above ^{14}C age is quoted in conventional years BP (before 1950 AD). The error, which is expressed at the one sigma level of confidence, includes components from the counting statistics on the sample, modern reference standard and blank and the random machine error.

The calibrated age ranges are determined from the University of Oxford Radiocarbon Accelerator Unit calibration program (OxCal4).

Samples with a SUERC coding are measured at the Scottish Universities Environmental Research Centre AMS Facility and should be quoted as such in any reports within the scientific literature. Any questions directed to the Radiocarbon Laboratory should also quote the GU coding given in parentheses after the SUERC code. The contact details for the laboratory are email g.cook@suerc.gla.ac.uk or telephone 01355 270136 direct line.

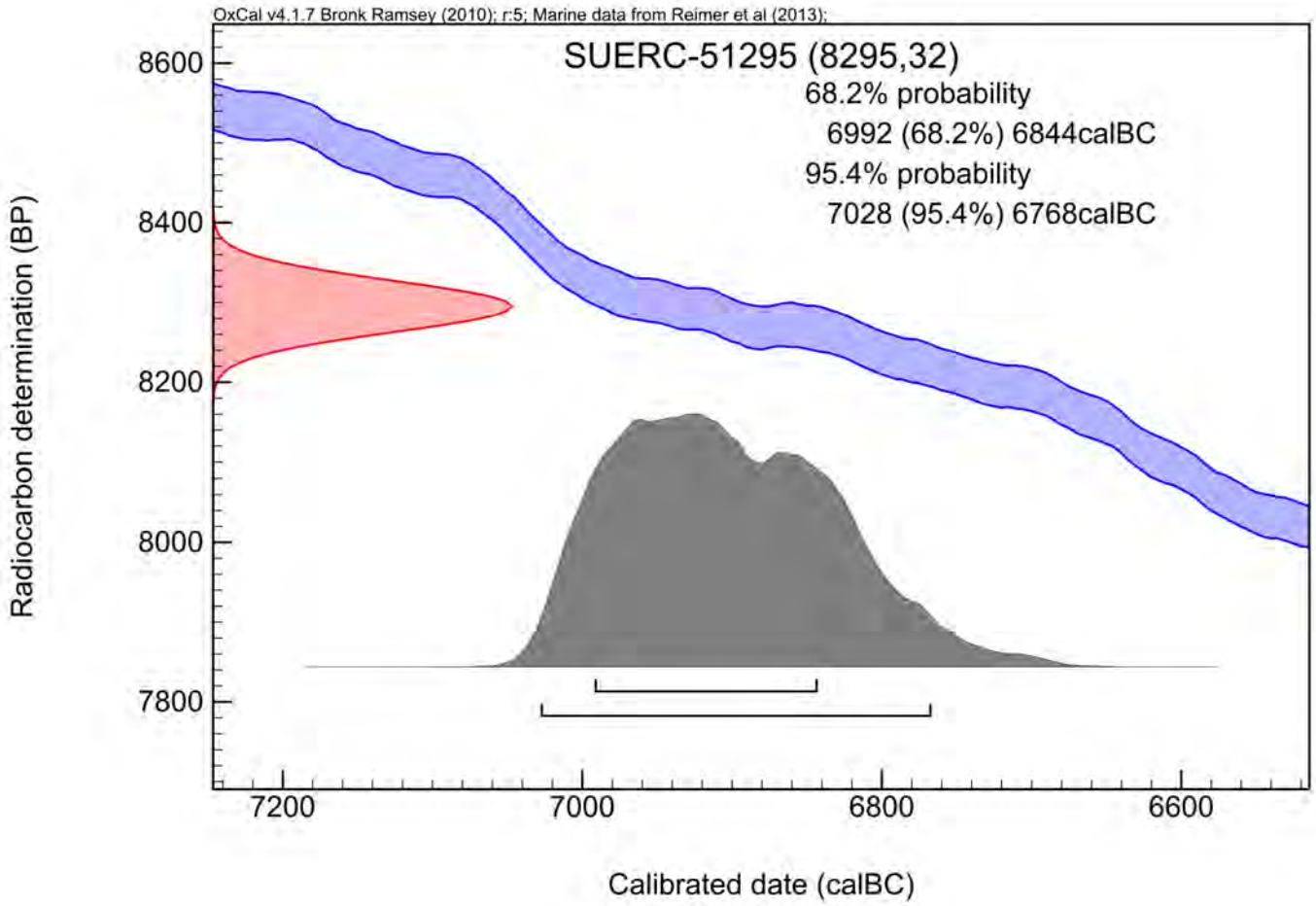
Conventional age and calibration age ranges calculated by :- N. Rudd Date :- 07/04/2014

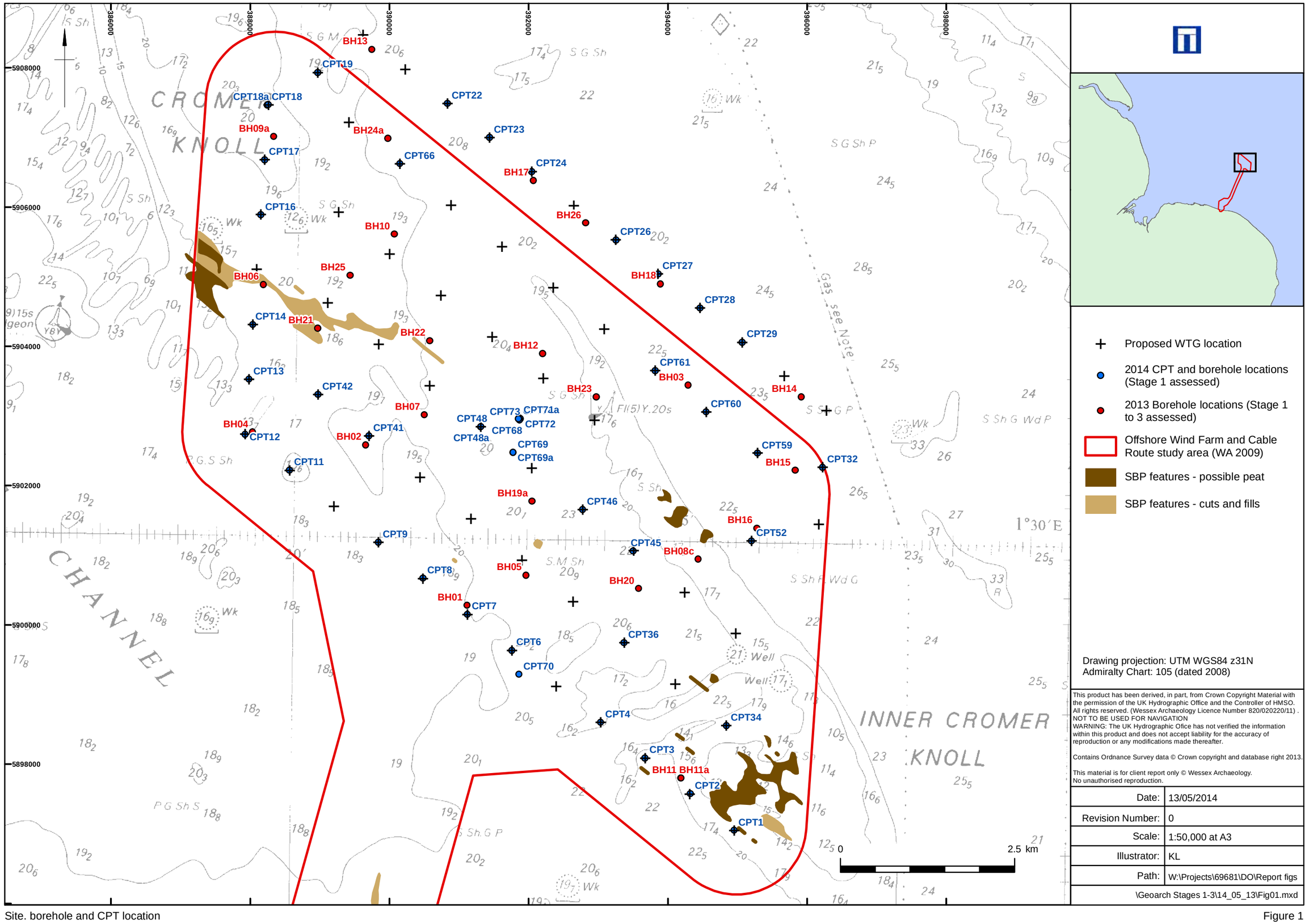
Checked and signed off by :- E Dunbar Date :- 07/04/2014

University of Glasgow

THE UNIVERSITY OF EDINBURGH

Calibration Plot





Proposed WTG location

2014 CPT and borehole locations (Stage 1 assessed)

2013 Borehole locations (Stage 1 to 3 assessed)

Offshore Wind Farm and Cable Route study area (WA 2009)

SBP features - possible peat

SBP features - cuts and fills

Drawing projection: UTM WGS84 z31N
Admiralty Chart: 105 (dated 2008)

Date:	13/05/2014
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Illustrator:	KL
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	\Geoarch Stages 1-3\14_05_13\Fig01.mxd

Site. borehole and CPT location

Figure 1

2.35m

5.30m

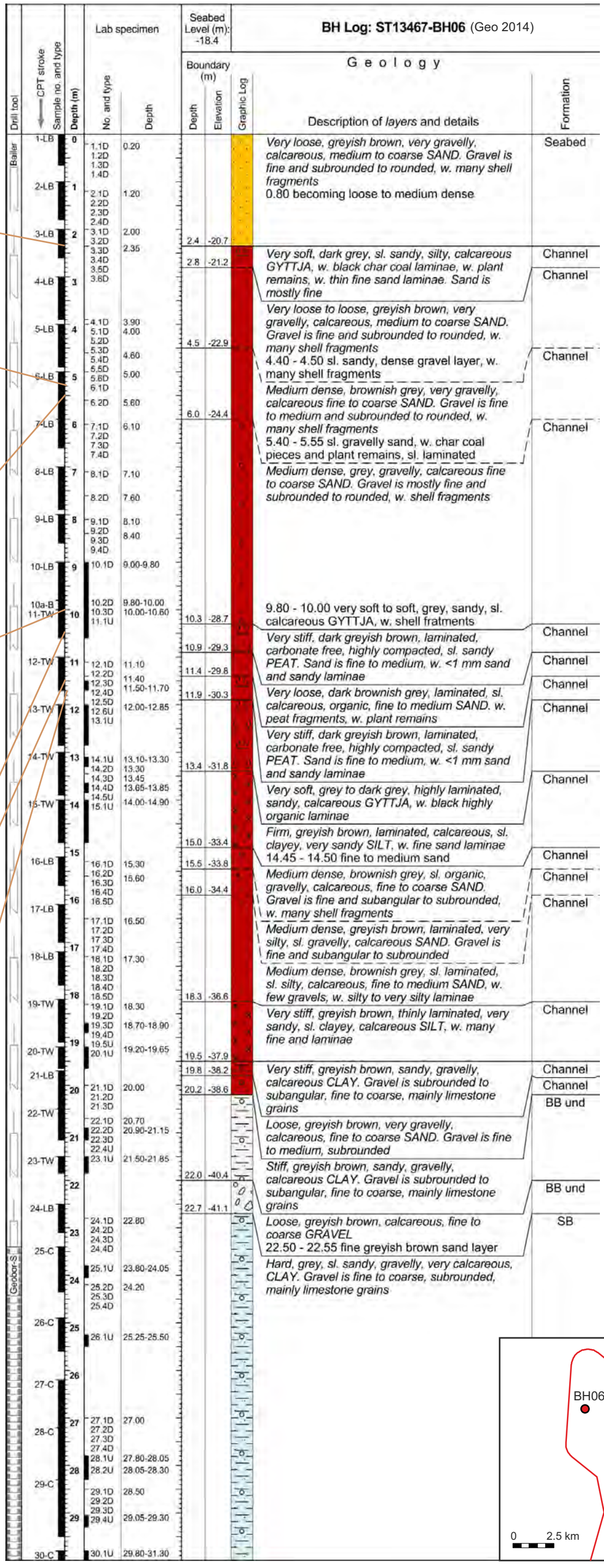
5.48m

10.05m

10.45m

11.50m

11.70m



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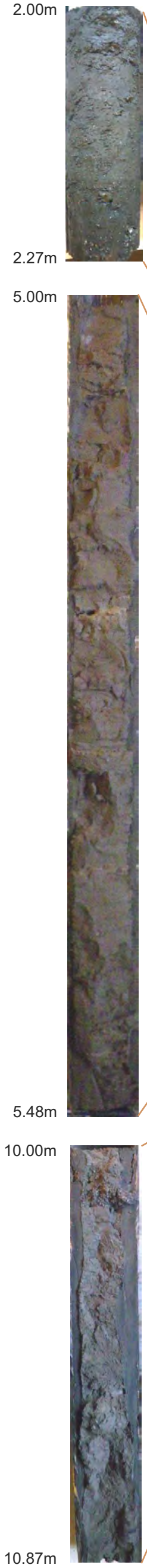
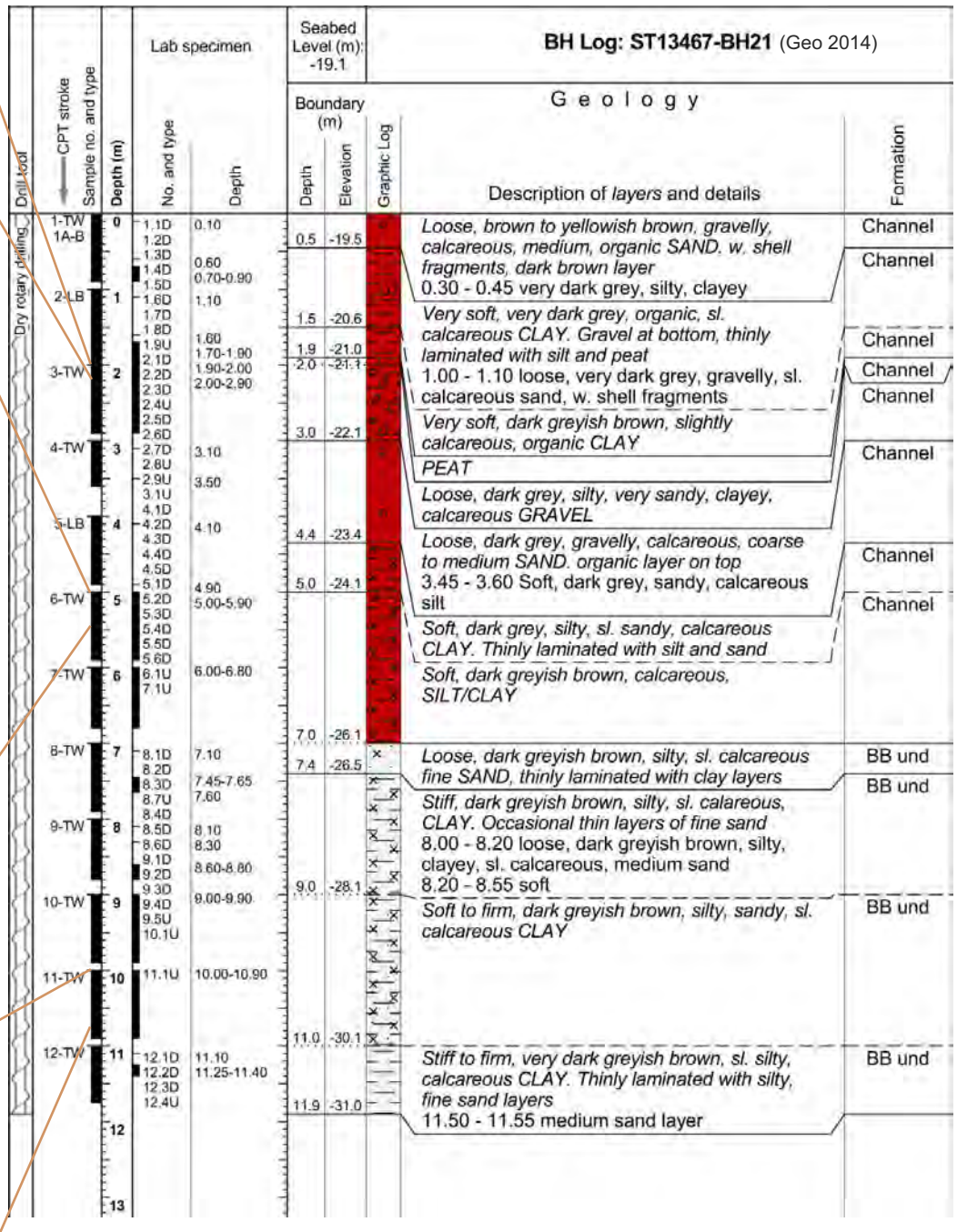
Borehole BH06 – Borehole log and Stage 3 subsampled sediments

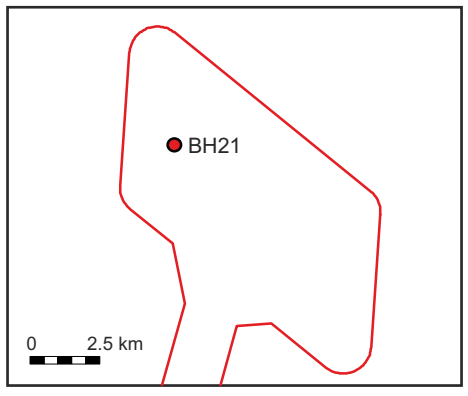
Figure 2





Stage 3 Sample depth — ^{14}C date

- 0.7m
- 1.97m
- 2.21m — +8996-8760 Cal BP
- 3.1m — +9108-8897 Cal BP
- 5.11m
- 10.81m



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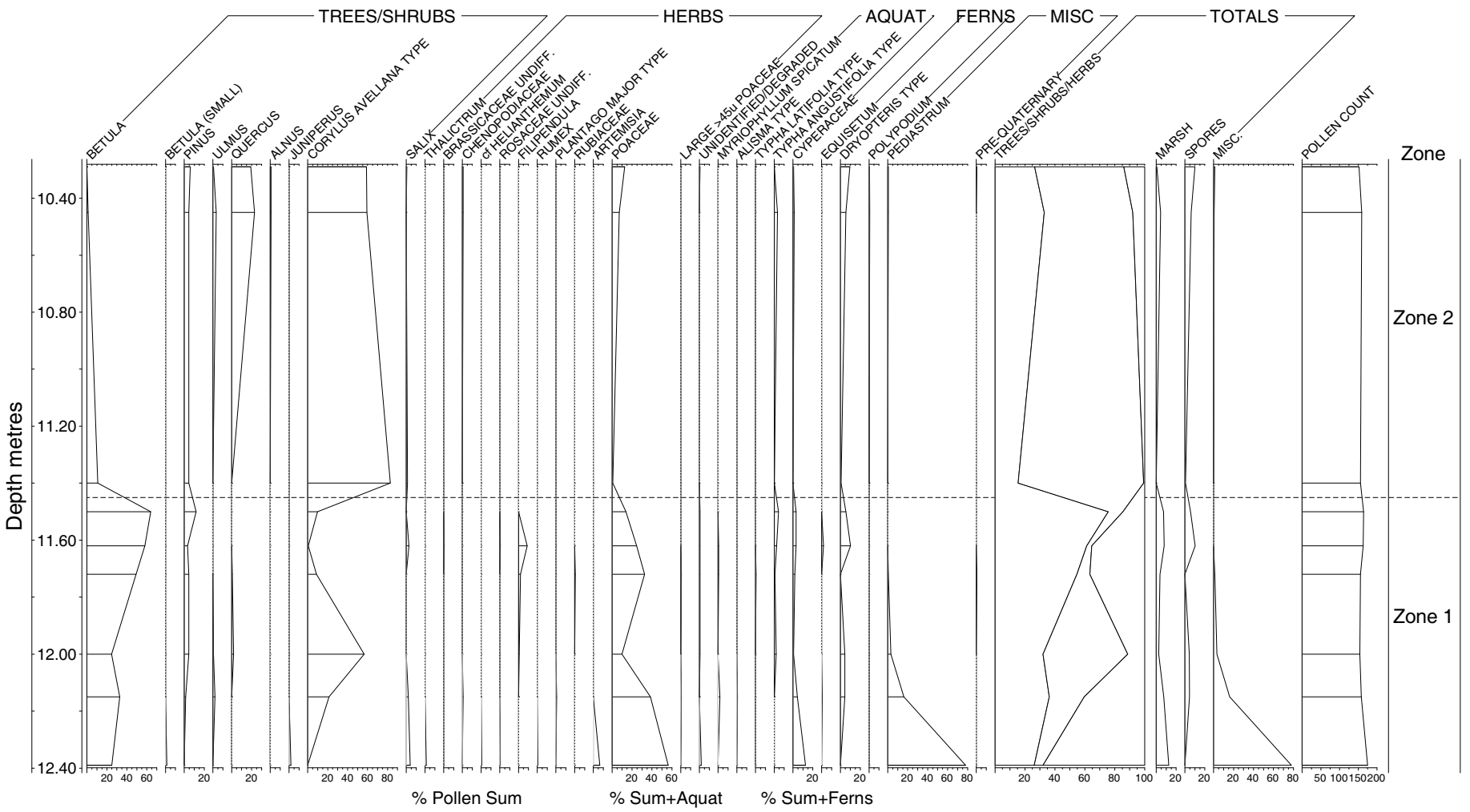
Borehole BH21 – Borehole log and Stage 3 subsampled sediments

Figure 3



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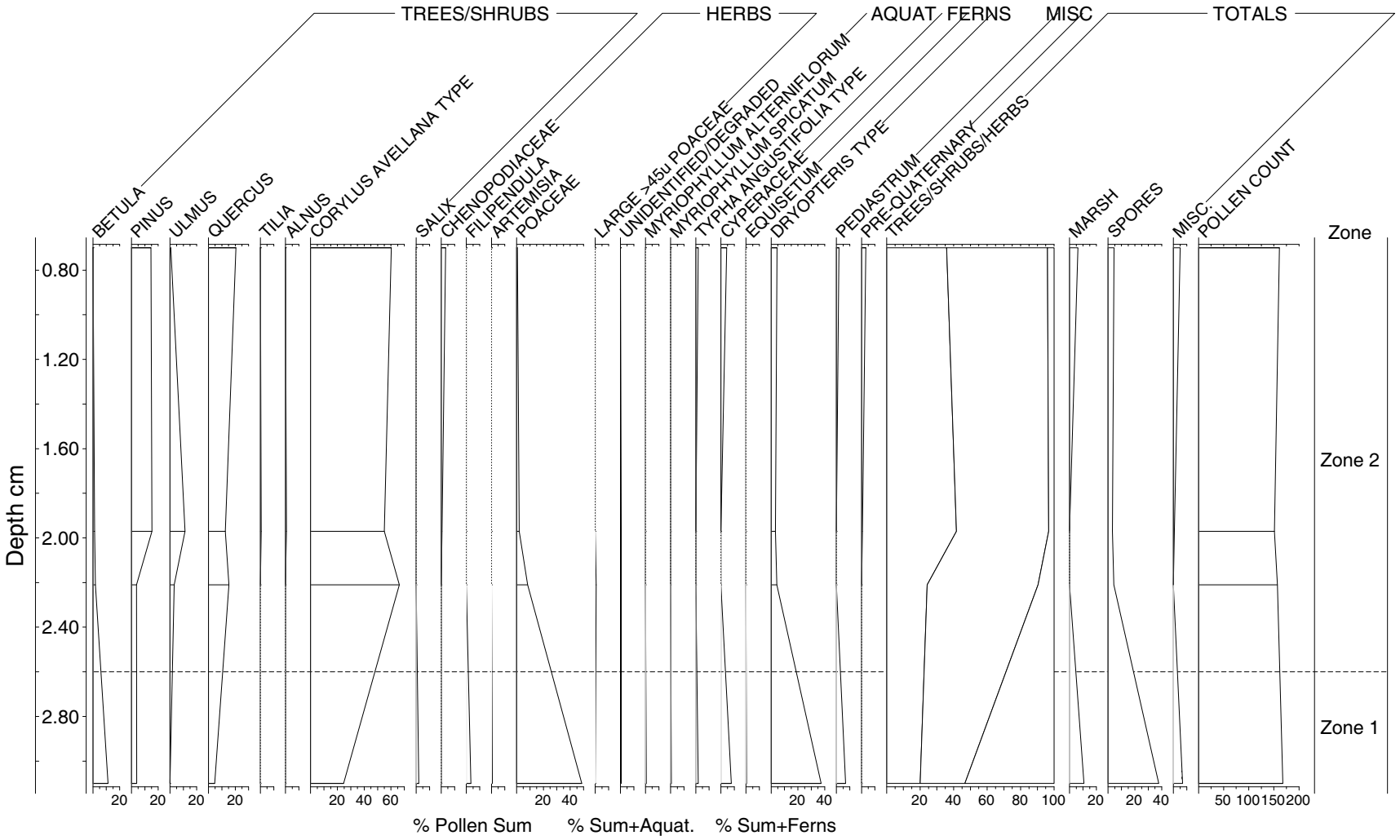
BH06 pollen diagram

Figure 4



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BH21 pollen diagram

Figure 5

wessex archaeology

salisbury rochester sheffield edinburgh

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