DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2013/44

Core photos and lithostratigraphy of the Sommerodde-1 core, Bornholm

Niels H. Schovsbo & Arne T. Nielsen

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GEUS

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1. Introduction

The Sommerodde-1 well (DGU 248.62) was drilled in November 2012 as part of the Geocenter Denmark financed project 'Silurian stratigraphy and basin development' awarded to Niels Schovsbo and Arne Thorshøj Nielsen (Figure 1). The aim of the well was to core the stratigraphically most complete Cambro-Silurian shale sequence onshore Bornholm. To achieve this goal the well was spudded near the south-eastern coast of Bornholm where the youngest known Silurian shales on Bornholm outcrop (Bjerreskov & Jørgensen 1983; Bjerreskov unpubl. investigations).

The purpose of this report is to present the core and to outline a preliminary log stratigraphy based mainly on the GR log response. The report is aimed for core workshop attendees.

The report is written prior to analysis and sedimentological logging of the cores and the outlined stratigraphy is thus likely to be slightly adjusted in due time. The preliminary stratigraphy is inferred based on comparison with the Billegrav-1 and -2 wells (Pedersen 1989; Schovsbo et al. 2011; Nielsen & Schovsbo 2012) and Bjerreskov (1975).

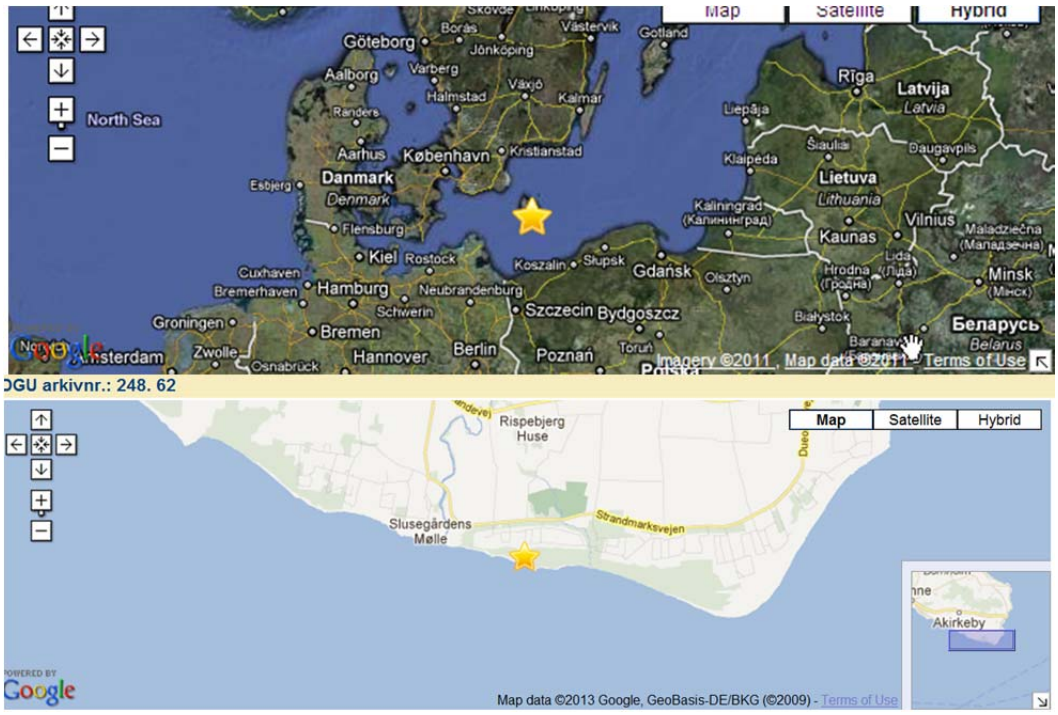

Figure 1. Map showing the location of the Sommerodde-1 (DGU 248.62) well on southern Bornholm, Denmark. Direct hyperlink to well information hosted at GEUS: http://data.geus.dk/JupiterWWW/borerapport.jsp?dgunr=248.62.

2. Well data summary sheet Sommerodde-1

DGU unique well id:	248.62
Common well name:	Sommerodde-1
Location, address:	Mølle Odde 15, 3720 Nexø, Bornholm
UTM zone	33
Drill Position, UTM:	501197, 6094480
Terrain elevation, m:	7.64 DNN
TD:	250.3 m depth below terrain
Formation at TD:	Læså Fm, Norretorp Mbr
Drilling type:	Diamond coring
Core diameter:	5.5 cm
Hole Diameter:	7.7 cm
Core barrel length:	3 m
Recovery:	From below 6.5 m: 100%
Drilling fluids:	Fresh water with no additives
Casing:	From 0-10 m
Drilling company:	Fakse Kalk A/S, Hovedgade 13, 4654 Fakse Ladeplads.
Drilling date:	4th November 2012 – 3rd December 2012
Logging:	8th-9th of January 2013 by Rambøll and 14th of January by GEUS
Purpose:	Scientific, stratigraphical evaluation
Location of cores:	GEUS core store, Valhøjs Alle 180, 2610 Rødovre
Summary:	The Sommerodde-1 well cored Silurian shales between 6.5-174.9 m, Ordovician shales above the Alum Shale between 174.9-218.3 m, Ordovician-Cambrian Alum Shale between 218.3-246.3 m and Lower Cambrian sand- and siltstone between 246.3-250.3 m. A total of 168.4 m Silurian shales were cored. The Lower Silurian Rastrites shale was completely cored and estimated to be 92.4 m thick in the well. The Alum Shale Formation is 27.7 m thick and includes the Middle Cambrian Andrarum and Exsulans limestone beds. The well was terminated at 250.3 m in the Norretorp Member of the Læså Fm after penetrating the Rispebjerg Mbr (3.5 m thick).

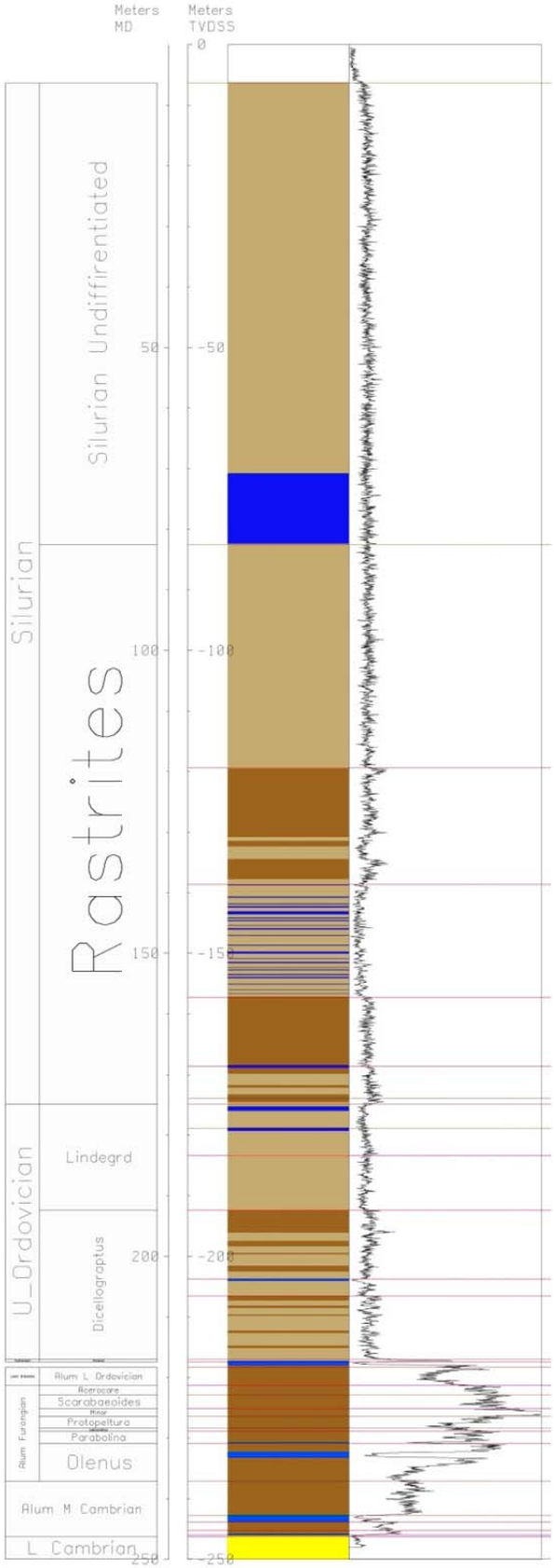

Figure 2. Synoptic log of the Sommerodde-1 well. Legend: yellow: sandstone; dark brown: dark shale; light brown: light grey-greenish shale; blue: limestone beds and carbonate cemented shale. Log curve: gamma ray curve obtained by GEUS. Log picks are presented in Table 2.

3. Well logs in Sommerodde-1

The Sommerodde-1 well was logged by Rambøll on the 8th-9th January 2013 and by GEUS on the 14th January 2013. The purpose of the Rambøll log acquisition was to characterise the formation whereas the purpose of the GEUS acquisition was to investigate the ground water, to establish the water flow zones and to take water samples in the well during test pumping.

The log types acquired are listed in Table 1. No problems were encountered during the acquisition and the planned analytical program was carried out.

Table 1. Overview of down-hole logs obtained in the Sommerodde-1 well by Rambøll and GEUS.

Name	Unit	Description
By Rambøll		
Gamma ray	API	Formation gamma ray response
Spectral gamma	API, %, ppm	Formation content of U, K and Th
Density (CDL)	ccm/g	Bulk density
Porosity	%	Neutron porosity
Sonic, Vp, Vs	Km/s	Sonic velocity
Resistivity	Ohm-m	Formation resistivity
Calliper	Mm	Borehole diameter
Susceptibility	CGS E5	Magnetic susceptibility of formation
Acoustic televiewer		Acoustic amplitude picture
Optic televiewer		RGB picture
By GEUS		
Gamma ray	API	Formation gamma ray response
Fluid temperature	degree C	Fluid temperature. No pumping
Fluid property	µS/cm	Fluid conductivity. No pumping
Flow rate	rpm	Flow log. No pumping
Flow rate	%	Scaled flow log

The temperature log shows a steady increase from 8°C in the topmost part increasing to 14°C in the basal part of the well. The resulting apparent geothermal gradient is thus 24°C / Km. The water conductivity is low in the upper 40-50 m and high stable values occur from below 130 m. An apparent maximum in conductivity is seen at about 210 m, which suggests that a small influx of low conductive water occur in the basal part of the well.

The water flow log shows highest inflow rates within the upper 40 m of the well. At depth the inflow rates decreases rapidly and the interval from below 80 m only contributes with about 20% of the total flow in the well. The low flow rate suggests that only few fractures are open in the shales and that these tend to occur in the upper part. This mode of occurrence is in good agreement with the high core quality and information from the optic and acoustic televiewer logs where only few open fractures were observed.

Water samples were collected after the flow zones were established. The water samples were picked as cumulated water samples at 10 m (water representing the entire well), at 235 m (water from levels in the Alum Shale) and at 245 m (water from the Lower Cambrian Sandstone).

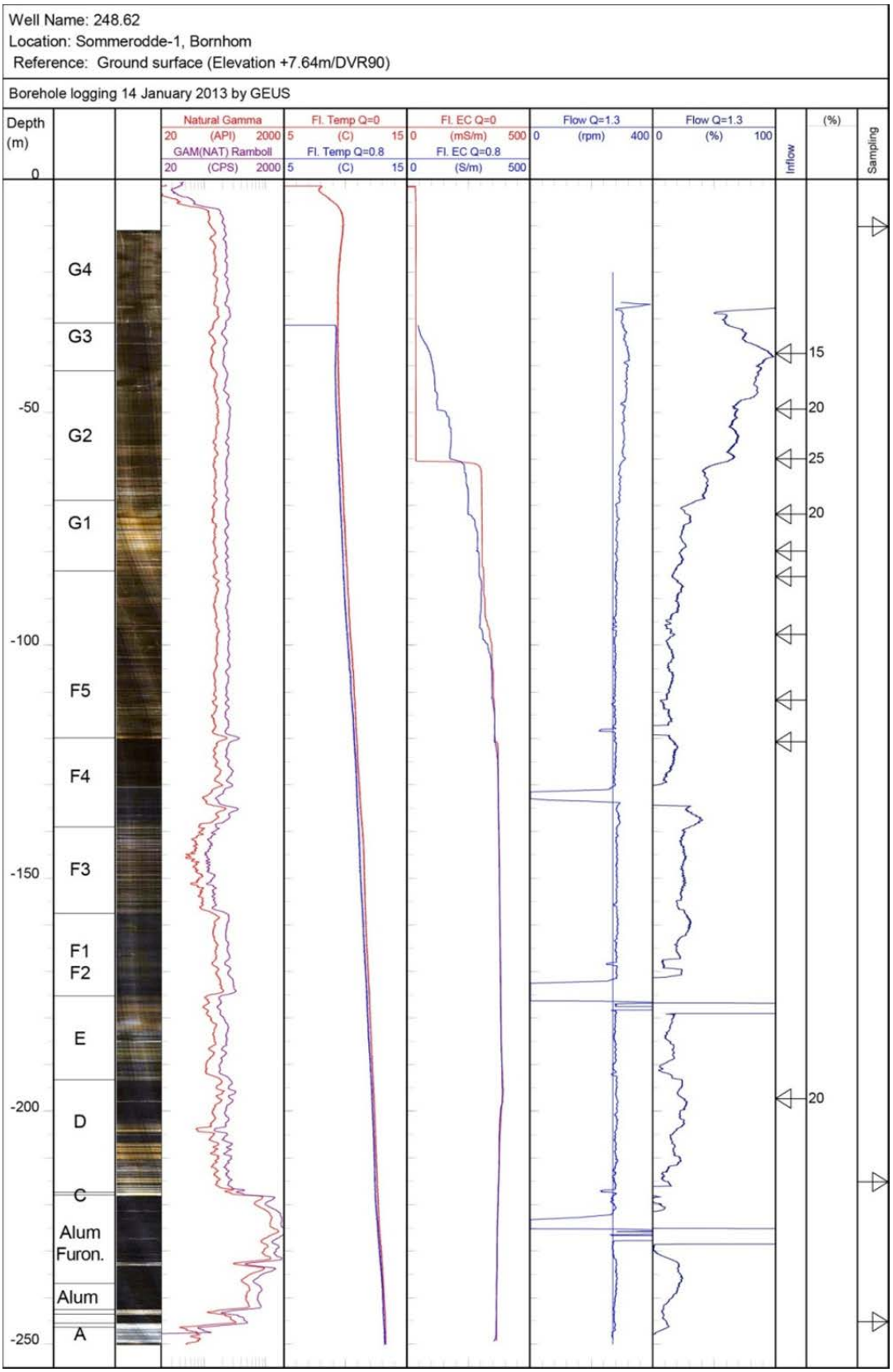

Figure 3. Logs measured in the Sommerodde-1 well by GEUS. Arrows pointing to the left indicate significant water inflow zones. Numbers indicate the percentage contribution to the total flow for each inflow zone. Arrows pointing to the right indicate position of water samples. The optic televiewer shown on the left is acquired by Rambøll.

4. Litho- and biostratigraphical frame for the Lower Palaeozoic of southern Scandinavia

4.1 Litho- and biostratigraphy

The Lower Palaeozoic litho- and biostratigraphical frame, developed for Bornholm, is outlined in Figures 4, 5, 6 and 7.

The Cambrian sand- and siltstones on Bornholm and southern Sweden (Scania) comprise the Nexø, Hardeberga, Læså and Gislöv Formations (Figure 4). For a recent review of these units, see Nielsen & Schovsbo (2006) and Nielsen & Schovsbo (2011).

The Nexø Fm comprises a reddish coloured subarkosic sandstone, overlain by a partially red-striped quartzitic sandstone, forming a transition to the overlying unit.

The Hardeberga Fm comprises well-sorted strongly cemented quartzite sandstone. The formation includes subordinate silt- and mudstone beds.

The Læså Fm is dominated by greenish grey siltstone with variable glauconite content. Phosphorite nodules occur at several levels and thin sandstone layers are common especially in the upper part of the formation. The top member, the Rispebjerg Member, is a regionally distributed sandstone bed that records a major regressive event (Figure 4).

The Alum Shale Fm consists of dark organic rich mudstone with abundant disseminated pyrite deposited in the Mid Cambrian to Early Ordovician (Tremadocian). In Denmark and Scania the formation has a relatively low content of diagenetic carbonate beds and nodules (Figure 5). This facies was termed the 'outer shelf type' by Schovsbo (2002). Alum Shale with higher proportions of non-shale beds including primary carbonates, conglomerates and diagenetic carbonate concretions are present in south-central districts of Sweden and on Öland (Figure 5). This facies was termed 'inner shelf' type by Schovsbo (2002). The Forsemölla, Exsulans and Andrarum limestones (all 0.1 to 1 m thick) occur in the lower part of the formation (Figure 5). These marker beds are primary bioclastic limestones and they represent periods with elevated oxygen at the sea-floor that allowed colonisation of a diverse benthic fauna (Schovsbo 2001 and Nielsen & Schovsbo 2006). The marker beds constitute important stratigraphical horizons that are readily recognised on gamma ray logs due to their low GR response.

Ordovician shales and limestone formations above the Alum Shale (Figure 6) comprise the Bjørkåsholmen Fm, Tøyen Shale, Komstad Limestone, Almelund Shale, Dicellograptus Shale (here used for the Sularp, Skagen, Mossen and Fjäcka shales of Scania) and the Lindegård Fm (previous referred to as the Jerrestad and Tommarp mudstones).

The Bjørkåsholmen Fm is a thin (<1 m) cold water bioclastic carbonate unit that contains variable amounts of clay, phosphorite and glauconite. It is not developed on Bornholm.

The Tøyen Shale is a relative thick unit in Scania, comprising greenish-grey mudstone with occasional siltstone beds. Dark organic rich intervals occur in the upper part of this shale in

the Olso area. A 10 cm thick light greenish grey shale has recently been drilled in the Billegrav-2 well and seems to represent a thin veneer of this formation which otherwise is unknown from Bornholm.

The Komstad Limestone is a thin-bedded cold water grey to dark grey bioclastic carbonate. The unit contains variable amounts of clay, phosphorite and glauconite. It is known from Bornholm and southern Sweden (Scania), but peters out westwards and is likely not present subsurface of Denmark. On Bornholm it is less than 5 m thick and locally even absent in wells in the Øleå area.

The Almelund Shale (previous referred to as the Upper Didymograptus and Lower Dicellograptus shale) is a black to dark-grey shale with rare carbonate interbeds. The shale does not occur on Bornholm.

The Dicellograptus Shale is a grey to blackish mudstone. The term Dicellograptus Shale is used here instead of the designations Sularp, Skagen, Mossen and Fjäcka shales, used for Scania by Bergström et al. (2002). The lower part of the Dicellograptus Shale contains numerous bentonite beds including the up to one meter thick 'Kinnekulle' Bentonite (corresponds to the Sularp Shale of Scania) which represents the most significant volcanic eruption in the entire Phanerozoic (Bergström et al. 2002).

The Lindegård Fm is a bioturbated green-grey mud- to siltstone. Thin sandstone beds with conglomeratic horizons occur in the uppermost part.

The Silurian is represented by the Rastrites and Cyrtograptus shales on Bornholm. Upper Silurian shales – assigned to the the Nøvling and Rønde Fms - are present in the Nøvling and Rønde wells in Jutland (Michelsen & Nielsen 1991). They are younger than the shales on Bornholm.

Silurian formations in Scania comprise the Rastrites, Cyrtograptus and Colonus shales in turn overlain by the Öved-Ramsåsa Group (Figure 7). The Rastrites, Cyrtograptus and Colonus shales were also penetrated by the Terne-1 well.

The Rastrites Shale (Figure 7) predominantly consists of black to dark-grey silty mudstones. Current generated sedimentary structures and calcite cemented sandy beds occur in some intervals. TOC rick intervals are present near the base of the formation and in the *L. convolutus* graptolite Zone (Schovsbo 2003).

The Cyrtograptus Shale (Figure 7) is dominated by grey silty mudstone (Bjerreskov 1975, Pedersen & Klitten 1990).

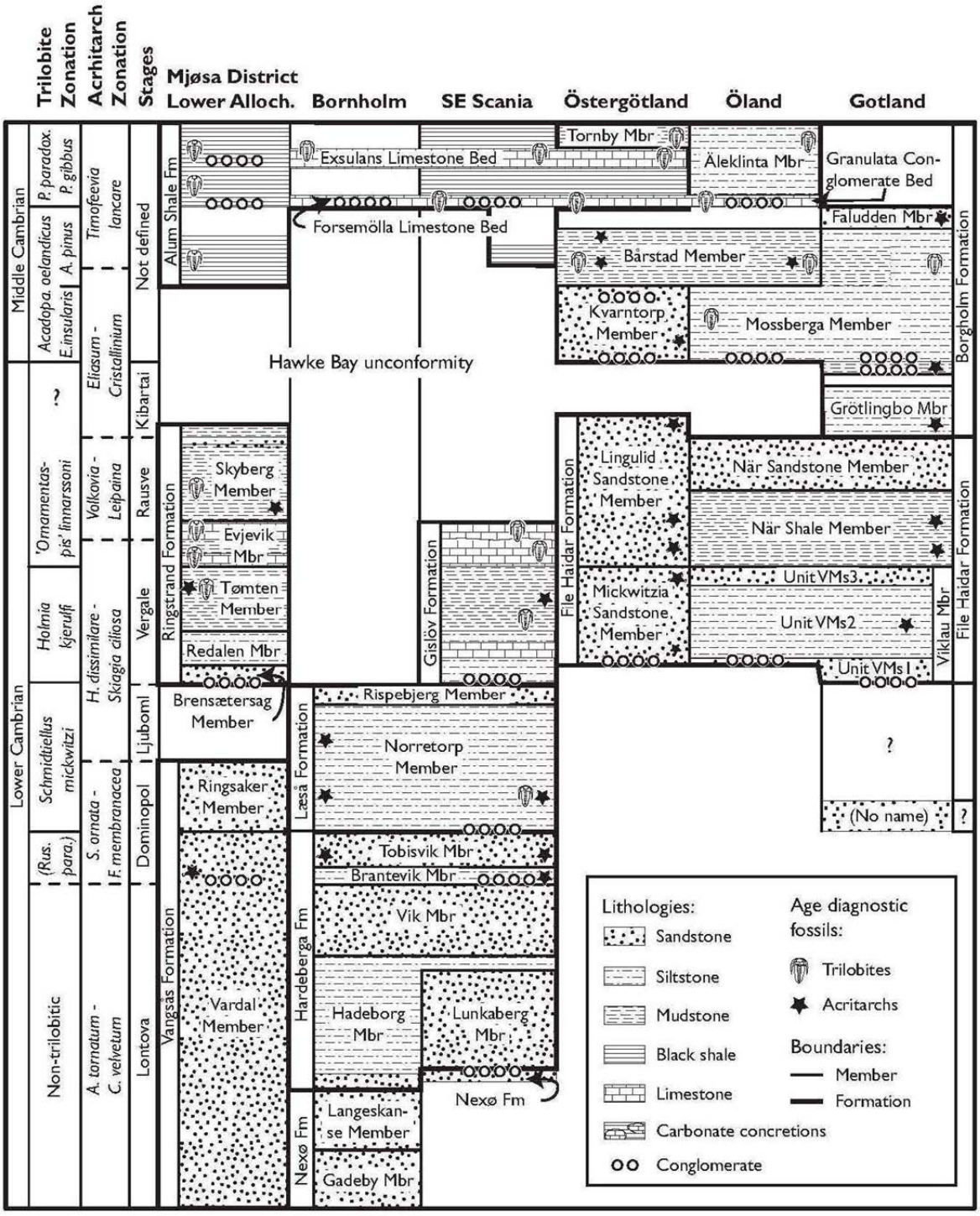

Figure 4. Lithostratigraphic scheme for the Lower and lower Middle Cambrian of southern Scandinavia. From Nielsen & Schovsbo (2006).

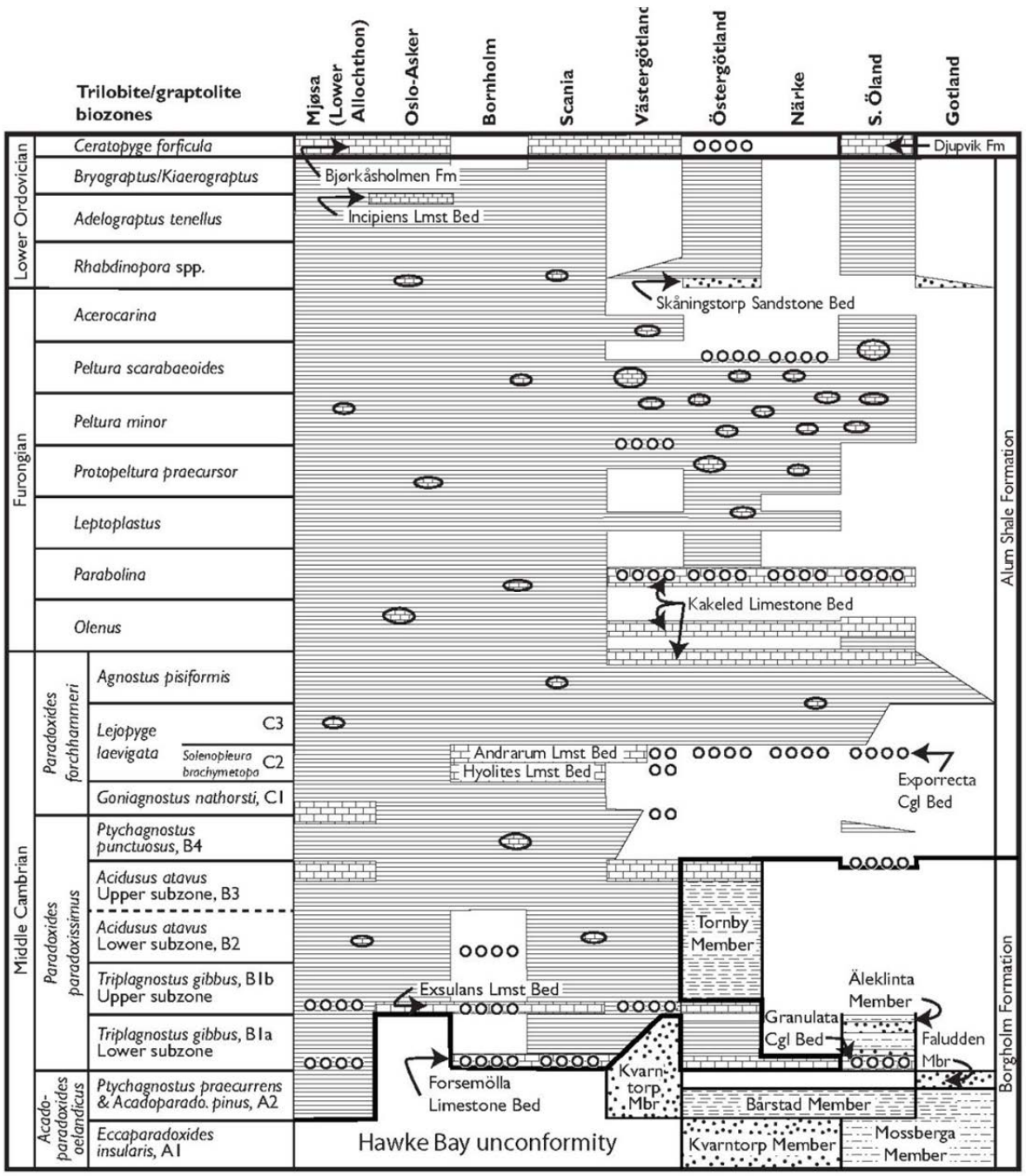

Figure 5. Lithostratigraphic scheme for the Middle Cambrian, Furongian and Lower Ordovician (Tremadocian) of southern Scandinavia. A very sophisticated biostratigraphy has been established for the Middle Cambrian and Furongian based on agnostid and olenid trilobites. Slightly modified from Nielsen & Schovsbo (2006).

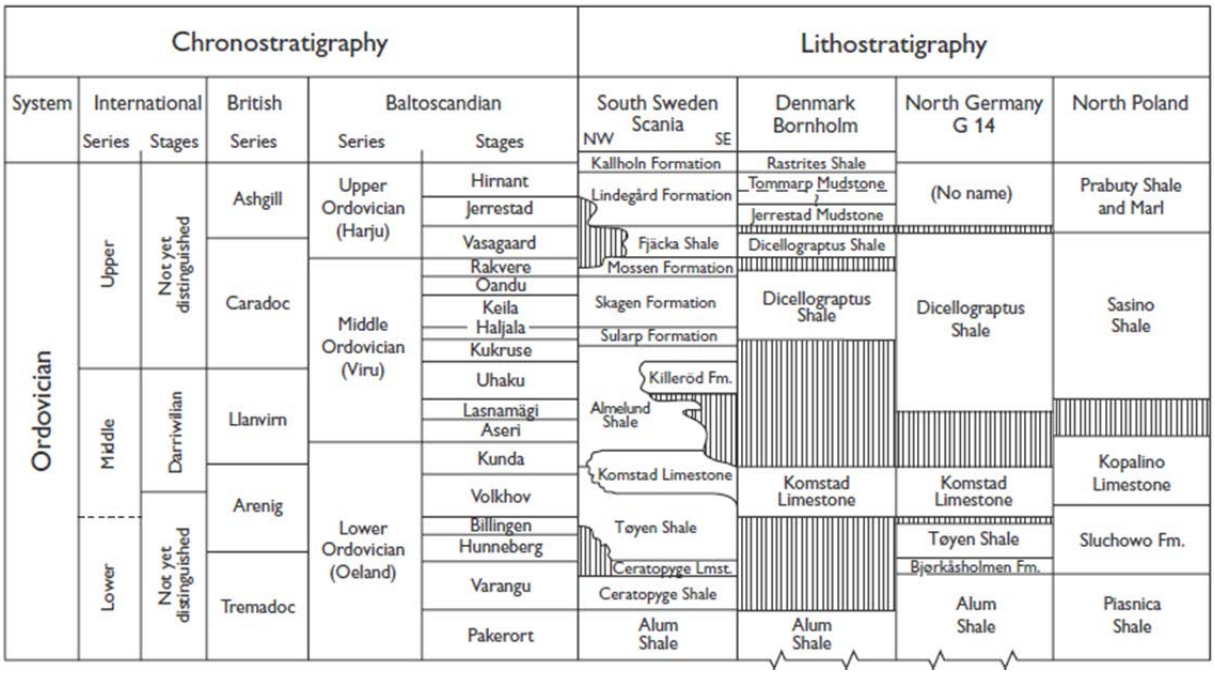

Figure 6. Ordovician stratigraphy of Scania, Bornholm, northern Germany (G14 well) and northern Poland with indications of main lithologies. From Stouge & Nielsen (2003).

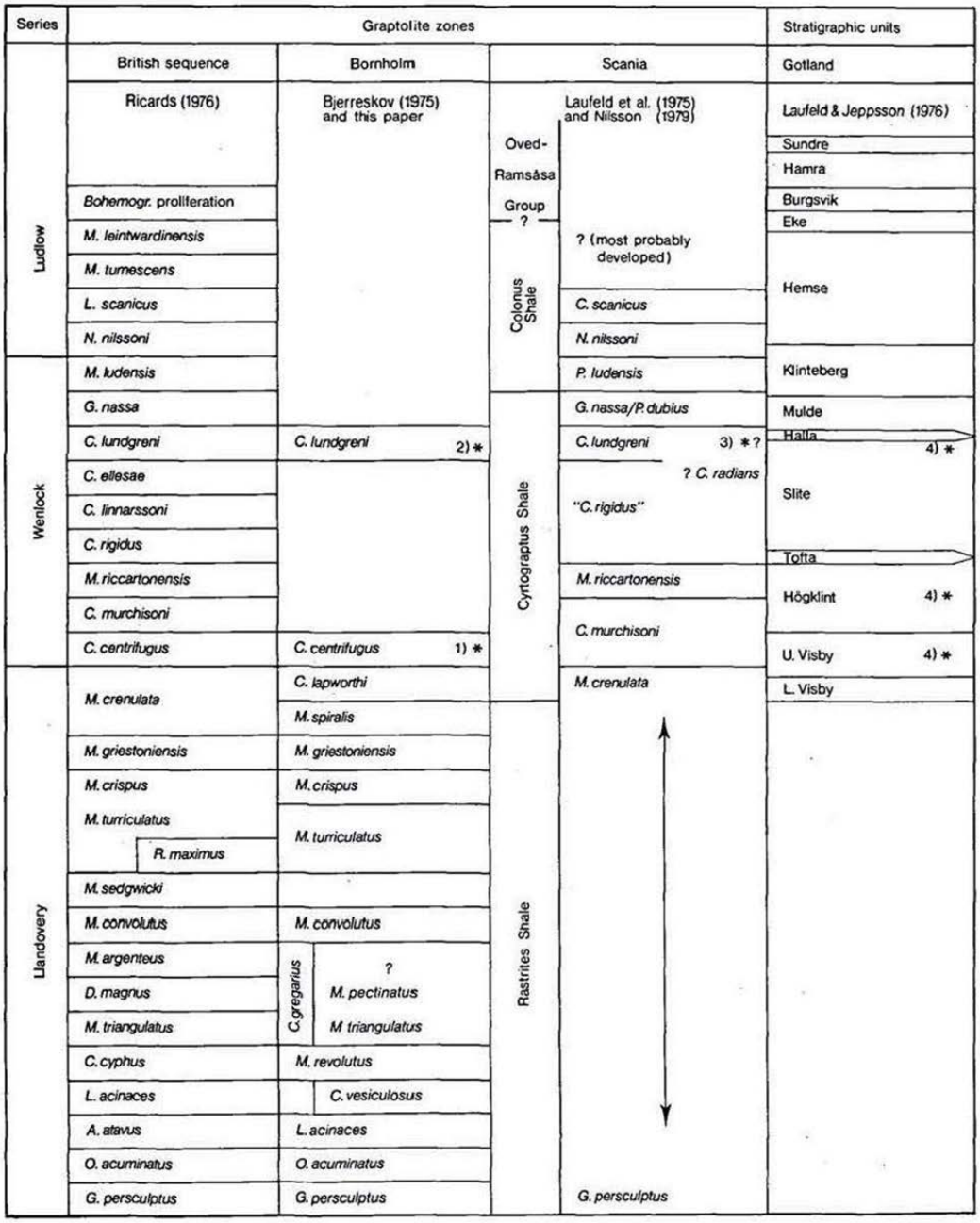

Figure 7. Silurian biostratigraphy of Bornholm and Scania (Bjerreskov 1975, Bjerreskov & Jørgensen 1983).

4.2 Logstratigraphical units on Bornholm

Pedersen & Klitten (1990) discerned 7 units (A-G) and 16 subunits based on the GR log pattern in water- and scientific wells on Bornholm and they performed detailed log based correlations in the local area (Figure 8). The log signatures of the units were expanded to also include the formation resistivity and sonic velocity by Schovsbo et al. (2011) and some adjustments of the correlations were introduced by Nielsen & Schovsbo (2012). Log stratigraphy of the Sommerodde-1 well is discussed in Section 5.

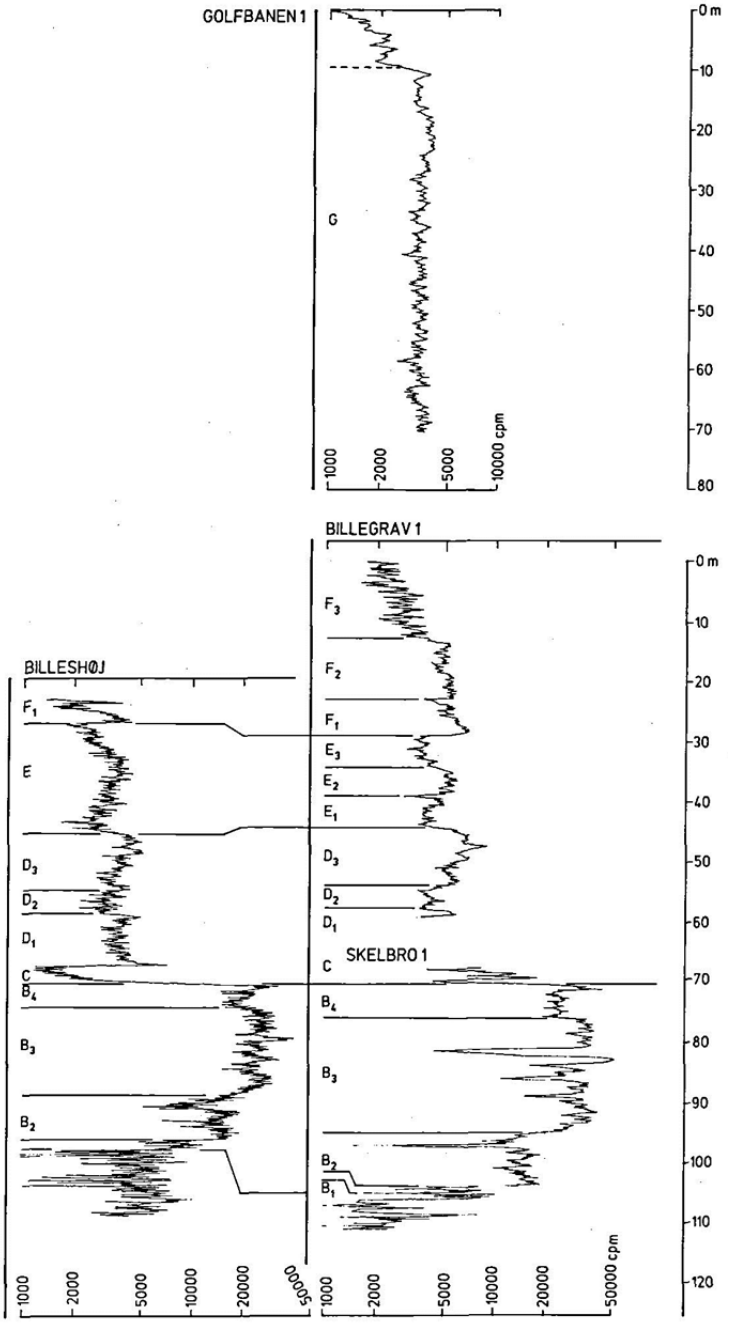

Figure 8. Example of correlation between the Billegrav-1, Billeshøj, Skelbro-1 and Golfbanen-1 wells on southern Bornholm. The A-G refers to the log units. From Pedersen & Klitten (1990).

Below follows a brief description of the log based units, based on Pedersen (1989), Pedersen & Klitten (1990) Nielsen & Schovsbo (2006) and Schovsbo et al. (2011). The biostratigraphy is inferred from Bjerreskov (1975), Koren & Bjerreskov (1997), Stouge & Nielsen (2003) and Nielsen & Schovsbo (2006).

The cited typical thicknesses and TOC content for each unit are based on the Skelbro and Billegrav-1 and -2 wells.

Unit A: Rispebjerg Member and top of the Norretorp Member, Læså Fm
Rispebjerg Member: Light grey medium to coarse grained quartz sandstone. The top part is impregnated with phosphorite.
The Norretorp Member is c. 100 m thick (Nielsen & Schovsbo 2006) and only the very top of the unit is reached by the Skelbro-1, Billegrav-2 and Sommerodde-1 wells. The unit was penetrated in its entirety by the Borggård-1 well (Nielsen & Schovsbo 2011). The upper part of the member is composed of sandy siltstone and fine silty sandstone with numerous sandstone beds. The unit is extensively bioturbated.
TOC: No sample (0% TOC assumed).
Age: Early Cambrian. *Schmidtiellus mickwitzi* trilobite Zone.

Unit B: Alum Shale Formation
The unit is characterized by very high gamma- readings and is readily identified on GR logs. The Alum Shale consists of black organic rich mudstone with beds and nodules of limestone. Barite and pyrite occur both as disseminated crystals and as nodules and sometime even thin layers.

Subunit B1: Exsulans Limestone and lower Middle Cambrian Alum Shale
The subunit top is characterized by low gamma values indicative of the base of the Andrarum Limestone. The B1 subunit represents the Exsulans Limestone (0.2 m) and Alum Shale (0.6 m). The Exsulans Limestone (on Bornholm probably amalgamated with the Forsemölla Limestone) is a primary bio-clastic carbonate bed.
TOC: 4% (one sample)
Age: Mid Cambrian (*P. paradoxissimus* to *P. forchhammeri* trilobite superzones).

Subunit B2: Andrarum Limestone and upper Middle Cambrian to basal Furongian Alum Shale: This log subunit is bounded upwards by a sharp increase in gamma ray readings and it represents an interval in the Alum Shale characterised by intermediate gamma values. The subunit contains in the Skelbro-1 well a diagenetic carbonate concretion (with low gamma readings) located about 3 m from the top of the subunit. The concretion contains abundant olenid trilobites and represents the basal part of the Furongian. Concretions of similar age, often amalgamated to form a semi-continuous bed, are also known from Scania (southern Sweden) and the limestone level is informally termed the ‘Olenus stinkstone’.
TOC: 5–8%
Age: Mid Cambrian (*P. forchhammeri* Superzone) to the lowermost Furongian (lower *Olenus* trilobite Superzone).

Subunit B3: Furongian Alum Shale The subunit comprises an interval characterised by very high gamma values. Top of the interval is placed at the start of a stepwise decrease in GR values. The high fluctuation in GR values in some intervals reflects the presence of diagenetic carbonate nodules and beds. A very distinct spike in the gamma values occurs in the middle of the subunit. A similar spike can be observed in numerous logged wells on Bornholm and in

Scania. The high GR readings occur in a shale level that represents the Furongian *Peltura minor* and *P. scarabaeoides* trilobite Superzones.
TOC: 8–14%
Age: Furongian (upper *Olenus* trilobite Superzone – *Acerocarina* [*Acerocare* of older literature] trilobite Superzone).

Subunit B4: Ordovician Alum Shale.
An interval characterised by intermediate GR values. The interval is bounded upwards by a very sharp drop in GR values reflecting the Komstad Limestone.
TOC: 4–9%
Age: Furongian (*Acerocarina* trilobite *Superzone*) – Early Ordovician (Tremadocian)

Unit C: Early Mid Ordovician Komstad Limestone
An interval characterised by very low GR readings reflecting the Komstad Limestone: The unit is a grey, thin-bedded cold water carbonate that contains variable amounts of clay, and locally also minor phosphorite and glauconite.
TOC: 0% (no samples - TOC assumed)
Age: Mid Ordovician (Dapingian-early Darriwilian)

Unit D: Dicellograptus shale
The unit is represented by grey to dark grey mudstone. It contains numerous bentonite beds in its lower part. The upper main part of the formation was penetrated by Billegrav-1 whereas the Billegrav-2 well penetrated the unit in its entirety.
Age: Late Ordovician (Sandbian-Katian), *Dicellograptus foliaceus to Pleurograptus linearis* graptolite Zones

Subunit D1: Dicellograptus Shale
The subunit is characterized by high GR readings. It is composed by grey mudstone with abundant bentonite beds. They are easily recognized due to their high GR readings. The subunit is bounded upwards by a local minimum in the GR values.
TOC: 0.5%
Age: Late Ordovician (Sandbian), roughly corresponding to the *Dicellograptus foliaceus* graptolite Zone

Subunit D2: Dicellograptus Shale
The subunit is characterized by high GR readings, and is composed of grey mudstone with few bentonite beds. The trace fossil *Chondrites* occurs frequently. The subunit is bounded upwards by a marked increase in GR values.
TOC: 0.1–1%
Age: Late Ordovician (Katian), roughly corresponding to the lower part of the *Dicranograptus clingani* graptolite Zone

Subunit D3: Dicellograptus Shale
The subunit is characterized by high GR readings and is upward bounded by an interval with very low GR values. The subunit is composed by dark graptolitic mudstone with a few thin bentonite beds.
TOC: 0.1–5%
Age: Late Ordovician (Katian) roughly corresponding to the upper part of the *Dicranograptus clingani* Zone and the *Pleurograptus linearis* graptolite Zone.

Unit E: Lindegård Formation
The unit is characterized by moderately high GR readings, and is composed by green-grey mud and siltstones that usually are highly bioturbated and calcareous. A few sandstone beds and thin conglomeratic horizons occur in the uppermost part. The unit contains a fairly rich shelly fauna whereas graptolites are known only from near the base of the unit and from immediately below top of the unit.
Age: Late Ordovician (late Katian – Hirnantian), *Dicellograptus complanatus – Normalograptus persculptus* graptolite zones

Subunit E1: Lindegård Fm
The subunit is characterized by low GR readings. The top is marked by a distinctive interval of low GR values. The subunit comprises grey mudstone intensely bioturbated in its top and base.
TOC: 0.1–0.4%
Age: Late Ordovician (Katian), likely roughly corresponding to the *Tretaspis granulata* trilobite Zone (*Dicellograotus complanatus* graptolite Zone).

Subunit E2: Lindegård Fm
The subunit is characterized by higher GR reading that the subunits above and below. The upper boundary is located at a low GR interval. The subunit are composed of grey green siltstone.
TOC: 0.1–0.2%
Age: Late Ordovician (Katian), likely roughly corresponding to the *Staurocephalus clavifrons* Zone (*Dicellograotus anceps* graptolite Zone?).

Subunit E3: Lindegård Fm
The subunit is characterized by very low GR readings. It is composed by silty mudstone with occasional sandstones, partially conglomeratic. The sandstone beds are carbonate cemented with up to 25% carbonate.
TOC: 0.1–0.2%
Age: Late Ordovician (Hirnantian), likely roughly corresponding to the *Dalmanitina mucronata* Zone (*Normalograptus extraordinarius-N. persculptus* graptolite zones?).

Unit F: Rastrites Shale
The formation is characterized by low to medium high GR readings. The total thickness of the Rastrites Shale is estimated at 80 m in the Øleå area (Bjerreskov 1975). Only the lower 29 m were penetrated by the Billegrav-1 well. The subunit is composed by silty mudstones, occasionally with current generated sedimentary structures, and grey siltstone which contains calcite cemented sandy beds in some intervals. Dark grey to black intervals occur.
Age: Late Ordovician-early Silurian (latest Hirnatian - Llandovery), *Normalogratus persculptus* graptolite zones.

Subunit F1: Rastrites Shale (23–29.2 m)
The base of the subunit is characterized by a very marked increase in GR readings. The basal part consists of approximately 1.5 m thick dark graptolitic mudstone with some silt beds. From here the GR values decreases and the top of the subunit is placed at a local minimum in GR values.
TOC: 0.4–3%
Age: Late Ordovician (Hirnantian) to early Silurian (Llandovery). *N. persculptus* to *A. accensus* graptolite zones.

Subunit F2: Rastrites Shale The subunit is characterized by intermediate high GR values. The top of the subunit is defined at a plateau in GR values just below a low GR interval. The subunit consits of grey siltstone with silty mudstone beds.
TOC: 0.5–1%
Age: Early Silurian (Llandovery), *P. acuminatus – O. vesiculosus* graptolite zones.

Subunit F3: Rastrites Shale
The subunit is characterized by low and variable GR values. The top is defined at a GR minimum just below a low GR interval. The subunit consist of grey siltstone with abundant calcite cemented sandy beds. The interval has a cyclic appearance on the log that is caused by alternating cemented sandy beds (low GR values) with silty mudstone (high GR values).
TOC: 0.5–0.8%
Age: Early Silurian (Llandovery), *O. vesiculosus – C. gregarious* graptolite Zone.

Subunit F4: Rastrites Shale (10 m in Billegrav-2)
The subunit is characterised by generally high but variable GR values. The top is defined by a marked decrease in GR values. This definition is a slight modification of Pedersen & Klitten (1990) who placed the top of the subunit a few metres above the marked decrease in GR values. However, moving the boundary slightly down gives a much better definition of the top and also limits the rock type in the subunit to black shale. The subunit consists of black organic rich mudstone.
TOC: 1.4–3.9%
Age: Early Silurian (Llandovery), *L. convolutus* graptolite Zone.

Subunit F5: Rastrites Shale (> 8 m thick, not drilled from the top in the Billegrav-2 well)
The subunit is characterised by rather low GR values and consist of grey siltstone.
TOC: 0.1-1.0
Age: Early Silurian (Llandovery), *S. sedwickii – ? M. spiralis* graptolite zones).

Unit G: Cyrtograptus shale (64 m drilled by the Golfbanen-1 well)
The unit was defined based on the GR signature in the un-cored water well 'Golfbanen-1 (248.54)' that penetrated a shale section between 7 and 79 m (Pedersen & Klitten 1990). The GR signature of the unit is very monotonous without characteristic lows and highs, likely reflecting a uniform lithology (Figure 8). The top of the G unit was picked at a marked decrease in GR response just above a sharp increase in GR reading at a depth of 8 m in the Golfbanen-1 well (Figure 8). Re-evaluation of the well data suggests, however, that the decrease in GR response rather reflects a combination of muting of the GR signal in the steel casing and that the upper 7 m of the penetrated section comprises less radiogenic Quaternary deposits. Accordingly, the log signature of the top of the G unit indicated by Pedersen & Klitten (1990) is considered an artefact. No subunits within the G unit were defined by Pedersen & Klitten (1990).
TOC: No samples analysed. Assumed less than 1% based on visual examination of cutting samples from the Golfbanen-1.
Age: Early Silurian (late Llandovery to early Wenlock), presumably *C. lundgreni – C. lapworthi* graptolite zones.

5. Logstratigraphy of the Sommerodde-1 well

A log stratigraphical characterization based primarily on the GR and the optic televiewer logs of the Sommerodde-1 well is presented in Figure 9 and in Table 2 and a log based correlation between the Sommerodde-1 and the Billegrav-2 well is presented in Figure 10.

Unit A: Lower Cambrian sand- and siltstone

Only the upper 4 m of Unit A is penetrated in the Sommerodde-1 well. The unit is characterised by very low GR values compared to the Alum Shale.

Unit B: The Alum Shale section

The Alum Shale is 28 m thick in the Sommerodde-1 well. The formation consists of dark black shale with subordinate limestone beds and concretions. Unit B is characterised by very high GR values that exhibit a very characteristic stepwise increase in GR value rising to peak values in the middle part of the formation from where the GR values upwards decreases in a stepwise manner (Figure 9).

Pedersen & Klitten (1990) defined 4 log subunits for the Alum Shale on Bornholm (Figure 8). As an alternative to these subunits Schovsbo& Nielsen (2012) defined a subdivision of the shale with a much higher stratigraphical resolution by introducing log picks that are closely related to the biostratigraphic zonal boundaries (Table 2).

The Middle Cambrian part of the Alum Shale in the Sommerodde-1 well is 9 m thick (including the *Agnosus pisiformis* Zone, which in older literature is assigned to the Upper Cambrian). The Middle Cambrian section includes the Andrarum and Exsulans Limestones that are easily identifiable based on low GR response and high resistivity response. The shale above the Andrarum Limestone is characterised by rather stable high GR values and the top of the Middle Cambrian is placed just below a slight decrease to lower GR values.

The Furongian part of the Alum Shale Formation is 17 m thick and characterised by very high GR values. The base of the Furongian is defined at a local minimum just before the GR values increases to levels that typically are twice as high as in the Middle Cambrian. Within the Furongian high GR values occur within the upper *Olenus* trilobite Superzone, the uppermost part of the *Parabolina* trilobite Superzone and in the *Peltura minor* trilobite Superzone. The latter maximum is the highest in the formation.

The Ordovician part of the Alum Shale is 2 m thick and characterised by lower GR values than the Furongian.

Unit C: Komstad Limestone (Middle Ordovician)

The Komstad limestone is 0.6 m thick and identified by its low GR and high resistivity response (Figure 11). The base of the limestone is developed as a conglomerate characterised by relative high GR response possibly due to the enrichment of uranium in the phosphatised pebbles or in glacony.

Unit D: Dicellograotus Shale (Upper Ordovician)

The tri-partition of the D unit is clearly expressed in the optic televiewer log where the occurrence of black shales and light coloured bentonite beds are very easily discerned (Figure 9).

The D1 subunit is 11.5 m thick and consists of interbedded bentonite and shale (this subunit corresponds to the Sularp Shale recognized in Scania). The subunit has a characteristic appearance on the resistivity log reflecting soft and less resistive bentonite alternating with hard resistive shale. The top of the D1 subunit is placed at a point of low GR response.

The D2 subunit is 3 m thick and consists of light to dark shale with few bentonite beds. The base is placed at an increase in GR values reflecting a darkening of the shale. The top is placed at a low GR response.

The D3 subunit is 10.1 m thick and characterised by dark shale. The log pattern is similar to that of a high GR unit. The top of the unit is placed at a point of decreasing GR values.

Unit E: Lindegård Mudstone (Upper Ordovician)

The E unit is 18 m thick and characterised by light green shale that is in part carbonate cemented. Sandstone beds also occur. The GR log response is lower compared to the above and below lying F and D units.

Unit F: Rastrites Shale (Llandovery, early Silurian)

The log stratigraphical subunits F1, F2, F3 and F4 are readily identified on the GR log and the optic televiewer signal (Figure 9). The F unit is 92.4 m thick in total.

Subunit F1. A 6.2 m thick dark green grey shale. The base on the subunit is defined by elevated GR log response.

Subunit F2. A 11.4 m thick dark green grey shale. The base on the subunit is characterised by elevated GR log response.

Subunit F3. A 18.7 m thick light grey green to light pale grey shale. The subunit is slightly thicker than in the Billegrav-2 well (Figure 10). In the Billegrav-2 well several fault zones occurred in this interval and it was suspected that parts of the section were faulted out. In the Sommerodde-1 no fault zones has been identified and it is believed that the thickness reflect true stratigraphical thicknesses.

The optic televiewer proved particular suited to resolve the lithological variations in the F3 subunit that are composed of rhythmically bedded shale and carbonate cemented shale. The pattern is probably reflecting diagenetic changes rather than Milankovitch cyclicity (Figure 9).

Subunit F4. 19.2 m thick dark black to dark green shales. The subunit is characterised by elevated GR log response. The middle part of the subunit is characterised by somewhat lower GR values.

Subunit F5. A 36.9 m thick dark grey to green shale. The upper boundary of the F5 subunit has not previously been observed in wells. It is here considered a marker for the top of the Rastrites Shale and, accordingly, probably corresponds to the top of the *M. spiralis* graptolite Zone (Figure 9). The overlying G unit of Pedersen & Klitten (1990) is thus corresponding to the traditional Cyrtograptus Shale.

In the Sommerodde-1 well the top of the F5 subunit is defined at a lithological transition from predominantly dark grey shale to lighter grey shale. The transition is gradual, but is placed at 82.5 m.

Unit G: Cyrtograptus Shale (Wenlock, early Silurian)
The G unit has not previously been subdivided. Based primarily on the optic televiewer log the G unit is here subdivided into 4 subunits each defined by a characteristic lithology and, to a lesser extent, GR-resistivity log pattern (Figure 9).

Subunit G1. A 12.5 m thick light green shale. The light colouring increases gradually from the basal part and towards the middle part of the unit. From here the light colouring decreases again toward the top of the unit. The subunit is primarily identified based on the optic televiewer log since it has an indistinct GR log response.

Subunit G2. A 30 m thick light grey to dark green shale. The top of the subunit is defined where an increase in the resistivity log occurs, reflecting a change to darker lithologies.

Subunit G3. A 10 m thick dark coloured shale unit. The subunit is clearly identified on the optic televiewer log and by a slightly lower GR log response and distinctly higher resistivity readings compared to the subunits above and below. The top of the subunit is defined at a point of decrease in the resistivity log.

Subunit G4. A 25 m thick light grey to green shale characterised by low and stable GR values. The subunit includes numerous silty to sandy beds similar to those exposed on the beach just south of the well location (Bjerreskov & Jørgensen 1983). The base of the subunit is placed at a point of increasing resistivity values corresponding to a change to dark lithologies seen in the optic televiewer log.

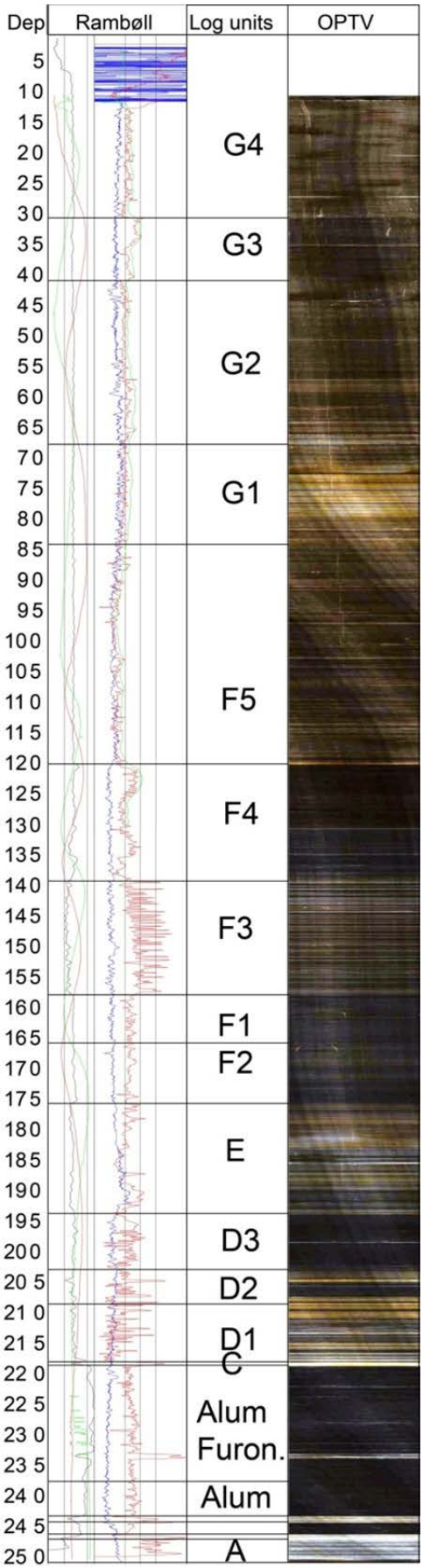

Figure 9. Logstratigraphical analysis of the Sommerodde well.

Table 2. Preliminary well pick depths for the Sommerodde-1 well. Pick depths from the Billegrav-2 and Skelbro-2 wells are from Schovsbo & Nielsen (2012).

Pick_name	Sommerodde-1	BILLEGRAV-2	SKELBRO-2
T_Prezechstein	6,4	4,5	2,7
G4_base	30,3		
G3_base	39,8		
G2_base	70,0		
G1_base	82,5		
F5_base	119,4	10,4	
F4_base	138,6	31,7	
F3_base	157,3	45,7	
F2_base	168,7	55,7	
Base_Silurian	173,9	60,2	
F1_base	174,9	61,1	
E3_base	178,9	63,9	
E2_base	183,4	68,7	
E1_base	192,4	73,8	
D3_base	203,8	84,5	
D2_base	206,5	87,6	
D1_base	217,0	95,4	
U_Ordovician	217,0	95,3	
top_komstad	217,4	95,4	2,7
top_toeyen	218,0	95,8	8,5
top_bjoerkaasholmen	218,0		
top_alum	218,0	95,8	8,5
top_D2	218,3	95,9	
top_D1	218,3	96,0	
top_furongian	220,4	98,5	11,6
top_scarabaeoides	222,9	101,2	14,5
top_minor	225,2	103,7	18,9
top_protopeltura	226,4	105,1	23,6
top_leptoplastus	228,4	107,0	25,9
top_parabolina	228,9	107,4	26,2
top_olenus	230,9	109,2	26,6
top_m_cambrian	237,1	115,8	34,2
top_lejopyge	240,1	118,9	37,2
top_andrarum	242,8	120,8	40,2
base_Andrarum	243,9	121,7	41,0
top_B2			
top_exsulans	245,3	123,0	41,6
base_Exsulans	246,0	122,4	42,0
base_forsamolla	246,0		
top_gislov	246,3	122,8	
top_laesaa	246,3	122,8	
top_Hardeberga			

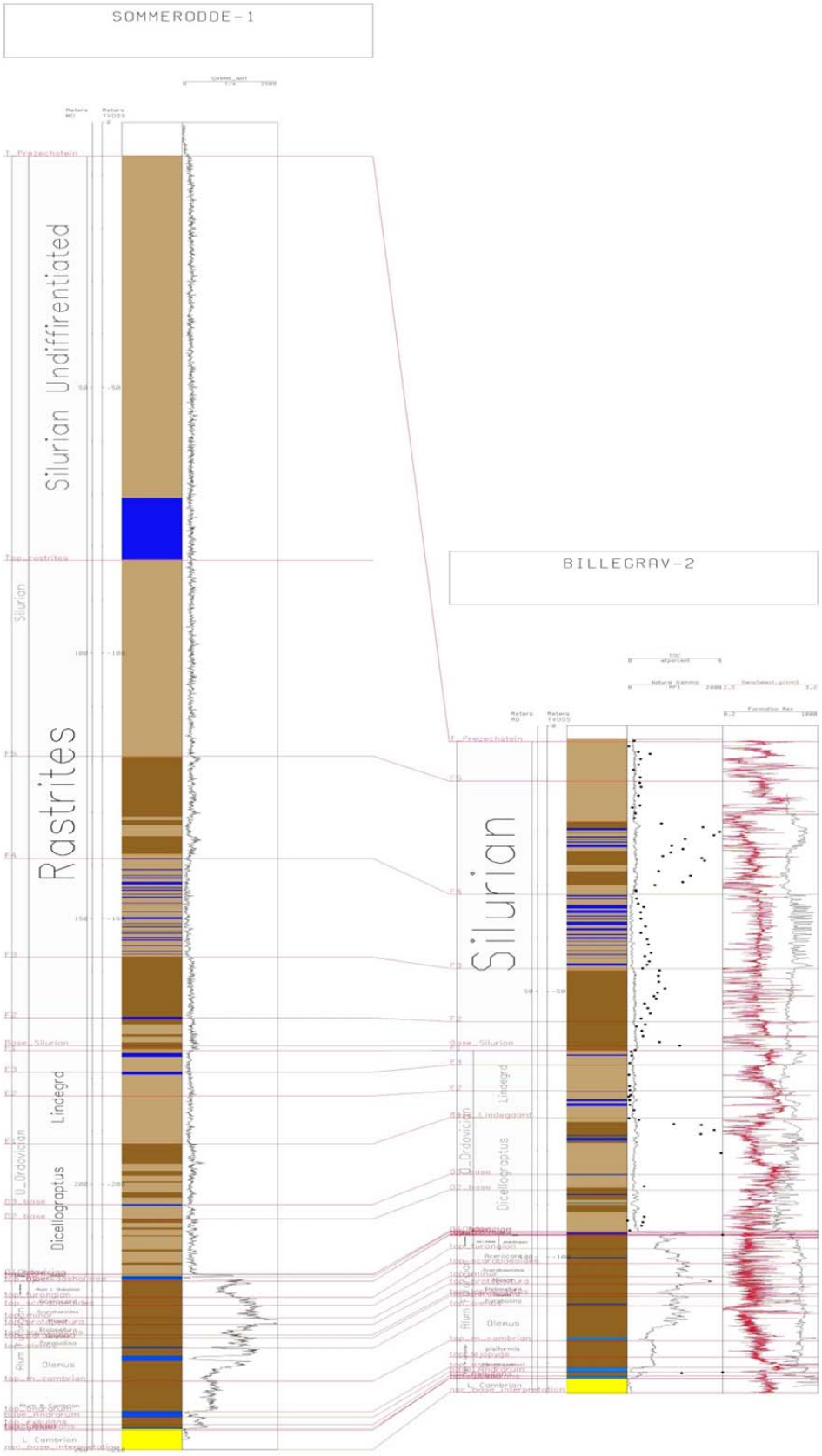

Figure 10. Correlation between the Sommerodde-1 and Billegrav-2 wells.

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Appendix A: Core Box data

Sommerodde 1 (248.62)

item	Box #	top (m)	base (m)	Section (m)
Box	1	5,50	9,80	4,3
Box	2	9,80	13,62	3,82
Box	3	13,62	17,15	3,53
Box	4	17,15	20,90	3,75
Box	5	20,90	24,50	3,6
Box	6	24,50	28,20	3,7
Box	7	28,20	31,85	3,65
Box	8	31,85	35,52	3,67
Box	9	35,52	38,90	3,38
Box	10	38,90	42,77	3,87
Box	11	42,77	46,20	3,43
Box	12	46,20	50,01	3,81
Box	13	50,10	53,65	3,55
Box	14	53,65	57,07	3,42
Box	15	57,07	60,67	3,6
Box	16	60,67	64,57	3,9
Box	17	64,57	68,24	3,67
Box	18	68,24	71,80	3,56
Box	19	71,80	75,45	3,65
Box	20	75,45	79,30	3,85
Box	21	79,30	83,15	3,85
Box	22	83,15	86,60	3,45
Box	23	86,60	89,90	3,3
Box	24	89,90	93,80	3,9
Box	25	93,80	97,26	3,46
Box	26	97,26	100,92	3,66
Box	27	100,92	103,93	3,01
Box	28	103,93	107,40	3,47
Box	29	107,40	111,12	3,72
Box	30	111,12	115,04	3,92
Box	31	115,04	118,66	3,62
Box	32	118,66	122,36	3,7
Box	33	122,36	126,10	3,74
Box	34	126,10	129,90	3,8
Box	35	129,90	133,50	3,6
Box	36	133,50	137,14	3,64
Box	37	137,14	140,86	3,72
Box	38	140,86	144,67	3,81
Box	39	144,67	148,20	3,53

item	Box #	top (m)	base (m)	Section (m)
Box	40	148,20	151,74	3,54
Box	41	151,74	155,34	3,6
Box	42	155,34	158,87	3,53
Box	43	158,87	162,63	3,76
Box	44	162,63	166,50	3,87
Box	45	166,50	170,25	3,75
Box	46	170,25	172,50	2,25
Box	47	172,50	176,28	3,78
Box	48	176,28	179,58	3,3
Box	49	179,58	183,25	3,67
Box	50	183,25	186,62	3,37
Box	51	186,62	190,28	3,66
Box	52	190,28	194,07	3,79
Box	53	194,07	197,4	3,33
Box	54	197,4	200,8	3,4
Box	55	200,8	204,47	3,67
Box	56	204,47	208,1	3,63
Box	57	208,1	211,4	3,3
Box	58	211,4	215	3,6
Box	59	215	218,4	3,4
Box	60	218,4	222,1	3,7
Box	61	222,1	225,9	3,8
Box	62	225,9	229,4	3,5
Box	63	229,4	232,96	3,56
Box	64	232,96	236,3	3,34
Box	65	236,3	239,8	3,5
Box	66	239,8	243,3	3,5
Box	67	243,3	246,5	3,2
Box	68	246,5	250,3	3,8

Appendix B: Screening samples

Screening samples Sommeroddde

well	Box	section	depth
SOM1	1	2	7,50
SOM1	1	3	8,40
SOM1	1	4	9,20
SOM1	2	1	10,06
SOM1	2	2	11,66
SOM1	2	3	12,02
SOM1	2	4	13,20
SOM1	3	1	13,81
SOM1	3	2	15,43
SOM1	3	3	16,30
SOM1	3	4	17,07
SOM1	4	1	17,50
SOM1	4	2	18,65
SOM1	4	3	19,40
SOM1	4	4	20,50
SOM1	5	1	21,07
SOM1	5	2	22,26
SOM1	5	3	23,24
SOM1	5	4	24,20
SOM1	6	1	25,00
SOM1	6	2	25,86
SOM1	6	3	26,93
SOM1	6	4	27,55
SOM1	7	1	28,50
SOM1	7	2	29,30
SOM1	7	3	30,25
SOM1	7	4	31,30
SOM1	8	1	32,02
SOM1	8	2	33,23
SOM1	8	3	34,12
SOM1	8	4	35,07
SOM1	9	1	35,89
SOM1	9	2	36,96
SOM1	9	3	37,90
SOM1	9	4	38,70
SOM1	10	1	39,15
SOM1	10	2	40,05
SOM1	10	3	41,60
SOM1	10	4	42,64
SOM1	11	1	43,07
SOM1	11	2	43,80
SOM1	11	3	44,75
SOM1	11	4	45,90
SOM1	12	1	46,60
SOM1	12	2	47,30
SOM1	12	3	48,15
SOM1	12	4	49,21
SOM1	13	1	50,70

well	Box	section	depth
SOM1	13	2	51,35
SOM1	13	3	52,23
SOM1	13	4	53,38
SOM1	14	1	54,15
SOM1	14	2	55,33
SOM1	14	3	56,02
SOM1	14	4	56,48
SOM1	15	1	57,17
SOM1	15	2	58,60
SOM1	15	3	59,50
SOM1	15	4	60,27
SOM1	16	1	61,14
SOM1	16	2	62,46
SOM1	16	3	63,12
SOM1	16	4	64,24
SOM1	17	1	64,81
SOM1	17	2	66,13
SOM1	17	3	66,91
SOM1	17	4	67,74
SOM1	18	1	68,53
SOM1	18	2	69,64
SOM1	18	3	70,59
SOM1	18	4	71,40
SOM1	19	1	72,74
SOM1	19	2	73,40
SOM1	19	3	74,55
SOM1	19	4	75,17
SOM1	20	1	75,94
SOM1	20	2	77,02
SOM1	20	3	78,21
SOM1	20	4	78,86
SOM1	21	1	79,88
SOM1	21	2	80,55
SOM1	21	3	81,87
SOM1	21	4	82,73
SOM1	22	1	83,48
SOM1	22	2	84,51
SOM1	22	3	85,67
SOM1	22	4	86,31
SOM1	23	1	86,68
SOM1	23	2	87,82
SOM1	23	3	89,05
SOM1	23	4	89,62
SOM1	24	1	90,51
SOM1	24	2	91,69
SOM1	24	3	92,63
SOM1	24	4	93,49
SOM1	25	1	94,37
SOM1	25	2	95,44

well	Box	section	depth
SOM1	25	3	96,06
SOM1	25	4	96,93
SOM1	26	1	97,70
SOM1	26	2	98,70
SOM1	26	3	99,91
SOM1	26	4	100,33
SOM1	27	1	101,45
SOM1	27	2	102,25
SOM1	27	3	102,64
SOM1	27	4	103,34
SOM1	28	1	104,26
SOM1	28	2	105,25
SOM1	28	3	106,11
SOM1	28	4	107,28
SOM1	29	1	107,60
SOM1	29	2	108,78
SOM1	29	3	109,65
SOM1	29	4	110,52
SOM1	30	1	111,69
SOM1	30	2	112,98
SOM1	30	3	113,42
SOM1	30	4	114,56
SOM1	31	1	115,46
SOM1	31	2	116,10
SOM1	31	3	117,52
SOM1	31	4	118,26
SOM1	32	1	119,37
SOM1	32	2	119,98
SOM1	32	3	120,91
SOM1	32	4	121,87
SOM1	33	1	122,55
SOM1	33	2	123,72
SOM1	33	3	124,66
SOM1	33	4	125,55
SOM1	34	1	126,55
SOM1	34	2	127,10
SOM1	34	3	128,46
SOM1	34	4	129,29
SOM1	35	1	130,35
SOM1	35	2	131,07
SOM1	35	3	132,36
SOM1	35	4	133,20
SOM1	36	1	133,93
SOM1	36	2	135,24
SOM1	36	3	135,74
SOM1	36	4	136,99
SOM1	37	1	137,87
SOM1	37	2	138,58
SOM1	37	3	139,78

well	Box	section	depth
SOM1	37	4	140,17
SOM1	38	1	141,53
SOM1	38	2	142,47
SOM1	38	3	142,80
SOM1	38	4	144,57
SOM1	39	1	145,09
SOM1	39	2	145,89
SOM1	39	3	146,89
SOM1	39	4	148,06
SOM1	40	1	148,66
SOM1	40	2	149,41
SOM1	40	3	150,60
SOM1	40	4	151,45
SOM1	41	1	152,63
SOM1	41	2	152,98
SOM1	41	3	154,12
SOM1	41	4	154,75
SOM1	42	1	155,99
SOM1	42	2	156,30
SOM1	42	3	157,60
SOM1	42	4	158,71
SOM1	43	1	159,48
SOM1	43	2	160,46
SOM1	43	3	161,65
SOM1	43	4	161,83
SOM1	44	1	162,76
SOM1	44	2	164,12
SOM1	44	3	165,45
SOM1	44	4	166,27
SOM1	45	1	166,95
SOM1	45	2	167,75
SOM1	45	3	169,04
SOM1	45	4	169,94
SOM1	46	1	170,65
SOM1	46	2	171,56
SOM1	46	3	172,45
SOM1	47	1	173,02
SOM1	47	2	173,92
SOM1	47	3	174,79
SOM1	47	4	175,96
SOM1	48	1	176,96
SOM1	48	2	177,28
SOM1	48	3	178,06
SOM1	48	4	179,13
SOM1	49	1	180,00
SOM1	49	2	181,07
SOM1	49	3	181,98
SOM1	49	4	182,47
SOM1	50	1	183,48

well	Box	section	depth
SOM1	50	2	184,33
SOM1	50	3	185,55
SOM1	50	4	186,30
SOM1	51	1	187,12
SOM1	51	2	188,28
SOM1	51	3	188,86
SOM1	51	4	190,14
SOM1	52	1	191,02
SOM1	52	2	191,86
SOM1	52	3	192,43
SOM1	52	4	193,77
SOM1	53	1	194,46
SOM1	53	2	195,11
SOM1	53	3	196,28
SOM1	53	4	197,20
SOM1	54	1	197,79
SOM1	54	2	198,35
SOM1	54	3	199,43
SOM1	54	4	200,36
SOM1	55	1	201,45
SOM1	55	2	201,89
SOM1	55	3	202,95
SOM1	55	4	204,32
SOM1	56	1	205,06
SOM1	56	2	205,68
SOM1	56	3	206,87
SOM1	56	4	207,54
SOM1	57	1	208,43
SOM1	57	2	209,20
SOM1	57	3	209,97
SOM1	57	4	211,06
SOM1	58	1	211,54
SOM1	58	2	212,83
SOM1	58	3	214,00
SOM1	58	4	214,54
SOM1	59	1	215,71
SOM1	59	2	216,51
SOM1	59	3	217,20
SOM1	59	4	218,26
SOM1	60	1	218,82
SOM1	60	2	220,10
SOM1	60	3	220,61
SOM1	60	4	221,72
SOM1	61	1	222,71
SOM1	61	2	223,71
SOM1	61	3	225,25
SOM1	61	4	224,71
SOM1	62	1	226,30
SOM1	62	2	226,95

well	Box	section	depth
SOM1	62	3	228,22
SOM1	62	4	228,89
SOM1	63	1	229,89
SOM1	63	2	230,64
SOM1	63	3	231,26
SOM1	63	4	232,37
SOM1	64	1	233,60
SOM1	64	2	234,16
SOM1	64	3	235,30
SOM1	64	4	236,10
SOM1	65	1	236,55
SOM1	65	2	237,29
SOM1	65	3	238,51
SOM1	65	4	239,46
SOM1	66	1	240,06
SOM1	66	2	241,45
SOM1	66	3	241,99
SOM1	66	4	242,70
SOM1	67	1	244,15
SOM1	67	2	244,75
SOM1	67	3	245,54
SOM1	68	4	249,13

Appendix C: Core photos


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # Box 1
top 5,50 m
base 9,80 m
9.60
8.40
7.20
cm
10
20
30
40
50
60
70
80
100


well
item # top base
Sommerodde 1 (248.62) Box 2 9,80 m 13,62 m
Bornholm, Lower Palaeozoic
cm
10
20
30
40
50
60
70
80
100
CORE ANALYSIS LABORATORY
9.01
13.5


CORE ANALYSIS LABORATORY
Blue Cyan Green Yellow Red Magenta White Brown Black
well item # top base
Sommerodde 1 (248.62) Box 3 13,62 m 17,15 m
Bornholm, Lower Palaeozoic
cm 10 20 30 40 50 60 70 80 100

well	item #	top	base
Sommerodde 1 (248.62)	Box 4	17,15 m	20,90 m

Bornholm, Lower Palaeozoic


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # top base
Box 5 20.90 m 24.50 m
cm
10
20
30
40
50
60
70
80
100


CORE ANALYSIS LABORATORY
well item # top base
Sommerodde 1 (248.62) Box 6 24,50 m 28,20 m
Bornholm, Lower Palaeozoic
26.9
cm
10
20
30
40
50
60
70
80
100

well	item #	top	base
Sommerodde 1 (248.62)	Box 7	28,20 m	31,85 m
Bornholm, Lower Palaeozoic			


CORE ANALYSIS LABORATORY
well item # top base
Sommerodde 1 (248.62) Box 8 31,85 m 35,52 m
Bornholm, Lower Palaeozoic
cm
10
20
30
40
50
60
70
80
100


well item # top base
Sommerodde 1 (248.62) Box 9 35,52 m 38,90 m
Bornholm, Lower Palaeozoic
cm
10
20
30
40
50
60
70
80
100
359
38.9
CORE ANALYSIS LABORATORY


CORE ANALYSIS LABORATORY
well
item # top base
Sommerodde 1 (248.62) Box 10 38,90 m 42,77 m
Bornholm, Lower Palaeozoic
cm
10
20
30
40
50
60
70
80
100


CORE ANALYSIS LABORATORY
well item # top base
Sommerodde 1 (248.62) Box 11 42,77 m 46,20 m
Bornholm, Lower Palaeozoic
cm
10
20
30
40
50
60
70
80
100


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # top base
Box 12 46.20 m 50.01 m
cm
10
20
30
40
50
60
70
80
100

well	item #	top	base
Sommerodde 1 (248.62)	Box 13	50,10 m	53,65

Bornholm, Lower Palaeozoic

well	item #	top	base
Sommerodde 1 (248.62)	Box 14	53,65 m	57,07
Bornholm, Lower Palaeozoic			

well	item #		top	base
Sommerodde 1 (248.62)	Box	15	57,07 m	60,67

Bornholm, Lower Palaeozoic


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # top base
Box 16 60,67 m 64,57
cm
10
20
30
40
50
60
70
80
100


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # top base
Box 17 64,57 m 68,24
659
cm
10
20
30
40
50
60
70
80
100


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62) Box 18
Bornholm, Lower Palaeozoic
item # top 68,24 m base 71,80
71.2
CORE DROPPED
68.9
CORE DROPPED
cm
10
20
30
40
50
60
70
80
100

well	item #	top	base
Sommerodde 1 (248.62)	Box 19	71,80 m	75,45
Bornholm, Lower Palaeozoic			


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # top base
Box 20 75,45 m 79,30
8.77
cm
10
20
30
40
50
60
70
80
100


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # top base
Box 21 79,30 m 83,15
80.8
cm
10
20
30
40
50
60
70
80
100


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # top base
Box 22 83.15 m 86.60
83.9
cm
10
20
30
40
50
60
70
80
100

well	item #	top	base
Sommerodde 1 (248.62)	Box 23	86,60 m	89,90
Bornholm, Lower Palaeozoic			


well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # top base
Box 24 89,90 m 93,80
CORE ANALYSIS LABORATORY
cm
10
20
30
40
50
60
70
80
100


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62) Box 25
Bornholm, Lower Palaeozoic
item # top 93,80 m
base 97,26 m
cm
10
20
30
40
50
60
70
80
100

well	item #	top	base
Sommerodde 1 (248.62)	Box 26	97,26 m	100,92 m
Bornholm, Lower Palaeozoic			

well	item	#	top	base
Sommerodde 1 (248.62)	Box	27	100,92 m	103,93 m

Bornholm, Lower Palaeozoic

well	item	#	top	base
Sommerodde 1 (248.62)	Box	28	103,93 m	107,40 m
Bornholm, Lower Palaeozoic				

well	item	#	top	base
Sommerodde 1 (248.62)	Box	29	107,40 m	111,12 m
Bornholm, Lower Palaeozoic				

well	item	#	top	base
Sommerodde 1 (248.62)	Box	30	111,12 m	115,04 m

Bornholm, Lower Palaeozoic


well
item # top base
Sommerodde 1 (248.62) Box 31 115,04 m 118,66 m
Bornholm, Lower Palaeozoic
CORE ANALYSIS LABORATORY
cm
10
20
30
40
50
60
70
80
100

well	item	#	top	base
Sommerodde 1 (248.62)	Box	32	118,66 m	122,36 m
Bornholm, Lower Palaeozoic				

well	item #	top	base
Sommerodde 1 (248.62)	Box 33	122,36 m	126,10 m
Bornholm, Lower Palaeozoic			

well	item	#	top	base
Sommerodde 1 (248.62)	Box	34	126,10 m	129,90 m

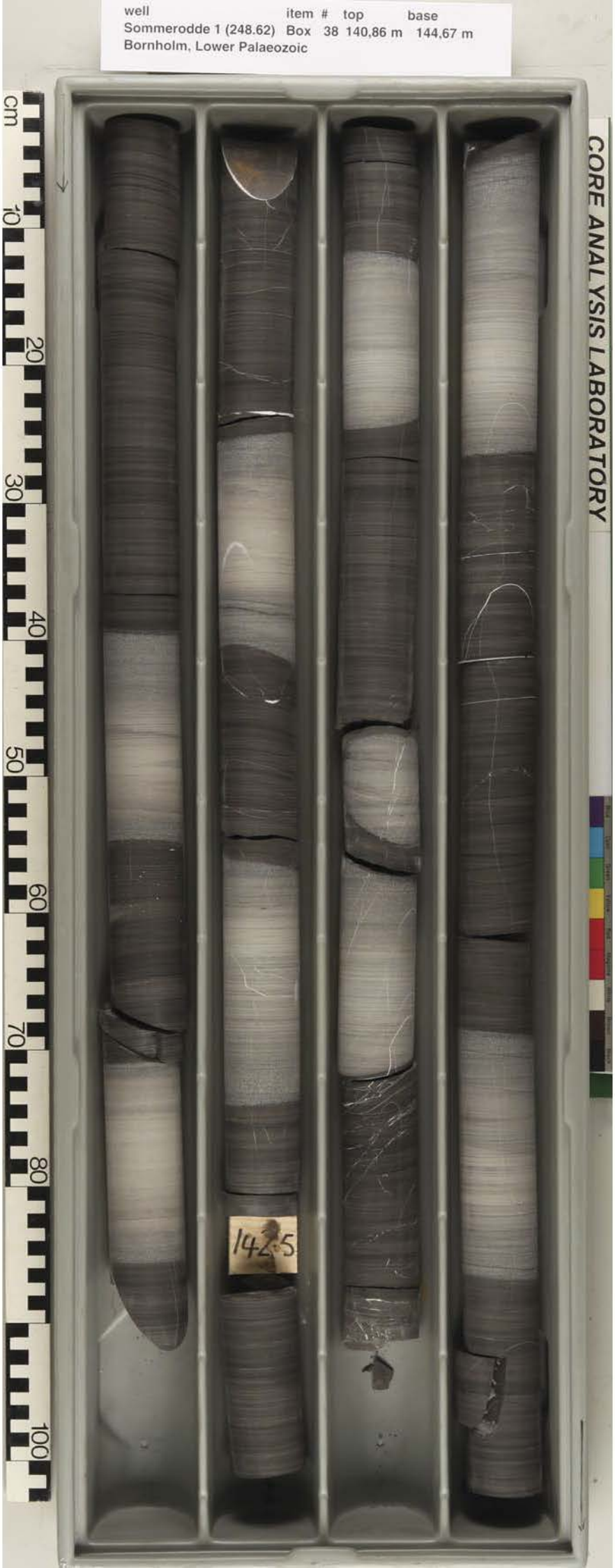
Bornholm, Lower Palaeozoic

well	item #	top	base
Sommerodde 1 (248.62)	Box 35	129,90 m	133,50 m
Bornholm, Lower Palaeozoic			

well	item	#	top	base
Sommerodde 1 (248.62)	Box	36	133,50 m	137,14 m

Bornholm, Lower Palaeozoic


well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # top base
Box 37 137,14 m 140,86 m
cm
10
20
30
40
50
60
70
80
100
139.5
CORE ANALYSIS LABORATORY


well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # top base
Box 38 140,86 m 144,67 m
CORE ANALYSIS LABORATORY
cm
10
20
30
40
50
60
70
80
100
142.5

well	item #	top	base
Sommerodde 1 (248.62)	Box 39	144,67 m	148,20 m
Bornholm, Lower Palaeozoic			

well	item #	top	base
Sommerodde 1 (248.62)	Box 40	148,20 m	151,74 m
Bornholm, Lower Palaeozoic			

well	item	#	top	base
Sommerodde 1 (248.62)	Box	41	151,74 m	155,34 m

Bornholm, Lower Palaeozoic

well	item	#	top	base
Sommerodde 1 (248.62)	Box	42	155,34 m	158,87 m
Bornholm, Lower Palaeozoic				

well	item #	top	base
Sommerodde 1 (248.62)	Box 43	158,87 m	162,63 m
Bornholm, Lower Palaeozoic			

well	item	#	top	base
Sommerodde 1 (248.62)	Box	44	162,63 m	166,50 m
Bornholm, Lower Palaeozoic				

well	item	#	top	base
Sommerodde 1 (248.62)	Box	45	166,50 m	170,25 m

Bornholm, Lower Palaeozoic


well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # Box 46
top 170,25 m
base 172,50 m
CORE ANALYSIS LABORATORY
172-5
cm
10
20
30
40
50
60
70
80
100

well	item #	top	base
Sommerodde 1 (248.62)	Box 47	172,50 m	176,28 m
Bornholm, Lower Palaeozoic			


well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
item # top base
Box 48 176,28 m 179,58 m
CORE ANALYSIS LABORATORY
cm
10
20
30
40
50
60
70
80
100
178.4

well	#	top	base
Sommerodde 1 (248.62)	49	179,6 m	183,25 m
Bornholm, Lower Palaeozoic			


well # top base
Sommerodde 1 (248.62) Box 50 183,3 m 186,62 m
Bornholm, Lower Palaeozoic
CORE ANALYSIS LABORATORY
cm
10
20
30
40
50
60
70
80
100
1844


well
Sommerodde 1 (248.62)
Bornholm, Lower Palaeozoic
Box
#
top
base
51
186,6 m
190,28 m
CORE ANALYSIS LABORATORY
cm
10
20
30
40
50
60
70
80
100
1874

well # top base
Sommerodde 1 (248.62) Box 52 190,3 m 194,07 m
Bornholm, Lower Palaeozoic


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62) Box 53
Bornholm, Lower Palaeozoic
top 194,1 m
base 197,4 m
cm
10
20
30
40
50
60
70
80
100


well # top base
Sommerodde 1 (248.62) Box 54 197,4 m 200,8 m
Bornholm, Lower Palaeozoic
cm
10
20
30
40
50
60
70
80
100
199.0
CORE ANALYSIS LABORATORY


CORE ANALYSIS LABORATORY
well # top base
Sommerodde 1 (248.62) Box 55 200.8 m 204.47 m
Bornholm, Lower Palaeozoic
2000
cm 10 20 30 40 50 60 70 80 100


well # top base
Sommerodde 1 (248.62) Box 56 204,5 m 208,1 m
Bornholm, Lower Palaeozoic
CORE ANALYSIS LABORATORY
cm
10
20
30
40
50
60
70
80
100
205
208·1

well	#	top	base
Sommerodde 1 (248.62)	Box 57	208,1 m	211,4 m
Bornholm, Lower Palaeozoic			

well		#	top	base
Sommerodde 1 (248.62)	Box	58	211,4 m	215 m

Bornholm, Lower Palaeozoic


CORE ANALYSIS LABORATORY
well
Sommerodde 1 (248.62) Box 59
Bornholm, Lower Palaeozoic
top 215 m
base 218,4 m
cm
10
20
30
40
50
60
70
80
100


well
Sommerodde 1 (248.62) Box # top base
Bornholm, Lower Palaeozoic 60 218,4 m 222,1 m
2204
CORE ANALYSIS LABORATORY

well		#	top	base
Sommerodde 1 (248.62)	Box	61	222,1 m	225,9 m

Bornholm, Lower Palaeozoic

well	#	top	base
Sommerodde 1 (248.62)	Box 62	225,9 m	229,4 m
Bornholm, Lower Palaeozoic			


well # top base
Sommerodde 1 (248.62) Box 63 229,4 m 232,96 m
Bornholm, Lower Palaeozoic
cm
10
20
30
40
50
60
70
80
90
100
1324
CORE ANALYSIS LABORATORY

well	#	top	base
Sommerodde 1 (248.62) Box	64	233 m	236,3 m

Bornholm, Lower Palaeozoic


well # top base
Sommerodde 1 (248.62) Box 65 236,3 m 239,8 m
Bornholm, Lower Palaeozoic
cm
10
20
30
40
50
60
70
80
100
238.4
CORE ANALYSIS LABORATORY

well	#	top	base
Sommerodde 1 (248.62) Box	66	239,8 m	243,3 m
Bornholm, Lower Palaeozoic			


well # top base
Sommerodde 1 (248.62) Box 67 243,3 m 246,5 m
Bornholm, Lower Palaeozoic
2443
CORE ANALYSIS LABORATORY
cm
10
20
30
40
50
60
70
80
100

well	#	top	base
Sommerodde 1 (248.62)	Box 68	246,5 m	250,3 m
Bornholm, Lower Palaeozoic