Palynology of a cored Rijswijk and Rodenrijs Claystone interval from well MON-GT-02

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Contents

Contents 3
1 Introduction 4
2 Material and Methods 6
2.1 Abbreviations used 6
2.2 Sample processing and counting 6
2.3 Lithostratigraphy of the Lower Cretaceous from the West Netherlands Basin 8
2.4 Methodology age assessment 8
2.5 Methodology paleoenvironmental interpretation 10
3 Results 12
3.1 Description of the palynological results 12
3.2 Age interpretation 13
3.3 Paleoenvironmental interpretation 14
3.4 The base of the Rijswijk Mb 14
3.5 Comparison with nearby well HON-GT-01 16
4 Conclusions 17
5 References 18
6 Signature 19

Appendices

Appendix 1 Photoplates
Appendix 2 Palynological distribution charts
2a Marine-terrestrial
2b Dinoflagellate cysts
2c Sporomorphs

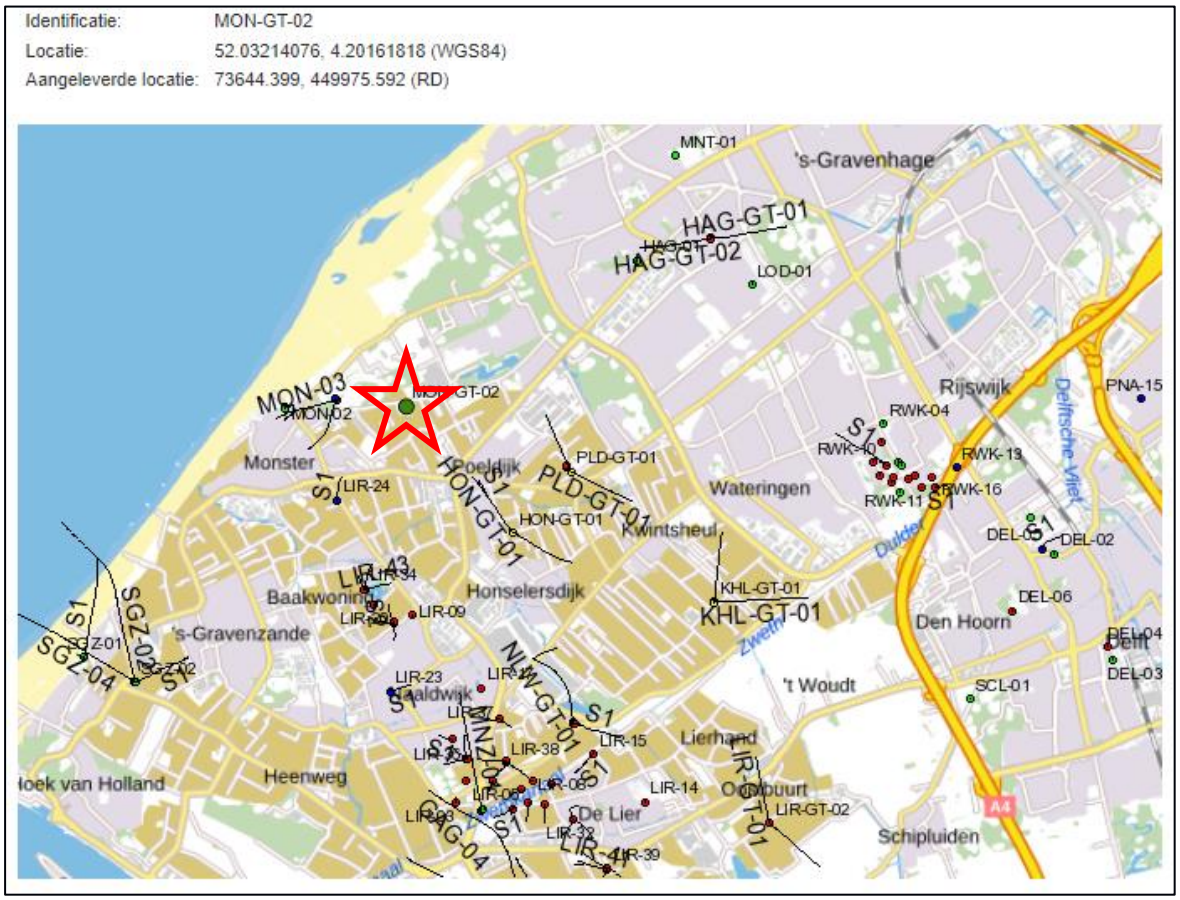
1 Introduction

In this report the results of a palynological analysis on a cored interval from well Monster-GT-02 (MON-GT-02) are presented. The well was drilled in 2023 by HVC Aardwarmte B.V. for the development of geothermal energy and is situated in Westland area, close to city of The Hague (Figure 1). Two cores were recovered across the transition from the Lower Cretaceous Rijswijk Member (Vlieland Sandstone Formation, Rijnland Group) to the Rodenrijs Claystone Member (Nieuwerkerk Formation, Schieland Group). The total length of the core is 60 meters along hole. The cored section ends in the lower part of the Rodenrijs Claystone Member, the core does not reach the geothermal aquifer of the Delft Sandstone Member.

The aim of the coring is to study the sealing capacity of the Rodenrijs Member. The aim of the palynological analyses is to document the age and palaeoenvironment of the selected interval. The Rijswijk Member and the Rodenrijs Claystone Member have been dated multiple times before, but never before on a continuous core. The availability of core samples also offers the opportunity to obtain reliable information on the depositional setting of the Rijswijk and Rodenrijs intervals.

The core samples were collected in close collaboration with the operator in June 2023 by Harmen Mijnlieff from TNO. The samples were processed in August 2023 by Nico Janssen from TNO and subsequently analysed and interpreted by Roel Verreussel from TNO. A litholog including the Gamma Ray trace (as image, not digital) and a preliminary lithostratigraphic interpretation of the studied interval was provided by the operator. Digital wireline logs were not available at the time of the analyses.

Figure 1 Location of well MON-GT-02. The olive-brown colours represent the greenhouses of the Westland area.



2 Material and Methods

2.1 Abbreviations used

TNO's standard abbreviations as used in palynology reports are listed in Table 1.

Table 1 List of abbreviations

CO	Core sample
SC	Side-wall core sample
CU	Cuttings sample
m	Meter
ft	Feet
MD	Measured Depth
LOD	Last Occurrence Datum
FOD	First Occurrence Datum
ND	Not Diagnostic

2.2 Sample processing and counting

A total of 61 core samples was collected from the tops of the one meter long cored intervals when these were still inside the steel barrel casings. From these 61 samples, 16 samples were selected for palynological analyses (Table 2). Because of the very low amounts of material, some samples were merged. Sample 2350.5m represent the merged raw sample material of samples 2350m and 2351m and sample 2359m represents the merged raw sample material of samples 2358m, 2359m and 2360m.

The samples were processed by Nico Janssen (TNO), using the standard sample processing procedures. This involves crushing and treatment with HCl to digest the carbonate. After that, the mineral bonds of the silicates are destroyed by applying HF, which releases the acid-resistant organic matter. The organic residue is then concentrated by sieving over a 7 micron mesh. The organic residue is put on a glass slide, fixed by a mounting medium such as glycerine jelly and covered by a thin glass cover slip. The palynological slides are studied using a transmitted light microscope with magnifications varying between 100 and 1000 microns. The dinoflagellate cysts and pollen and spores are identified on species level and counted up to 100 specimens (if possible). The occurrences of the different species are displayed on palynological distribution charts. These charts are the basic modules for the age and palaeoenvironmental interpretation (Appendix 2).

Table 2 (next page) Sample list. The lithostratigraphic assignments were provided by the operator.

Well	core number	CORE depth [m]	small amount	lithostrat	Merged samples	Palynological Analyses
MON-GT-02	#1	2350	*	Rijswijk	2350	
MON-GT-02	#1	2351	*	Rijswijk	2351	2350,5
MON-GT-02	#1	2352	*	Rijswijk		
MON-GT-02	#1	2353	*	Rijswijk		
MON-GT-02	#1	2354		Rijswijk		2354
MON-GT-02	#1	2355	*	Rijswijk		
MON-GT-02	#1	2356	*	Rijswijk		
MON-GT-02	#1	2357	*	Rijswijk		
MON-GT-02	#1	2358	*	Rijswijk	2358	
MON-GT-02	#1	2359	*	Rijswijk	2359	2359
MON-GT-02	#1	2360		Rijswijk	2360	
MON-GT-02	#1	2361	*	Rijswijk		
MON-GT-02	#1	2362	*	Rijswijk		
MON-GT-02	#1	2363	*	Rijswijk		
MON-GT-02	#1	2364	*	Rijswijk		2364
MON-GT-02	#1	2365		Rijswijk		2365
MON-GT-02	#1	2366		Rodenrijs		
MON-GT-02	#1	2367	*	Rodenrijs		2367
MON-GT-02	#2	2368		Rodenrijs		2368
MON-GT-02	#2	2369	*	Rodenrijs		
MON-GT-02	#2	2370	*	Rodenrijs		
MON-GT-02	#2	2371	*	Rodenrijs		
MON-GT-02	#2	2372	*	Rodenrijs		
MON-GT-02	#2	2373	*	Rodenrijs		2373
MON-GT-02	#2	2374	*	Rodenrijs		
MON-GT-02	#2	2375	*	Rodenrijs		
MON-GT-02	#2	2376	*	Rodenrijs		
MON-GT-02	#2	2377	*	Rodenrijs		
MON-GT-02	#2	2378	*	Rodenrijs		
MON-GT-02	#2	2379		Rodenrijs		2379
MON-GT-02	#2	2380		Rodenrijs		
MON-GT-02	#2	2381		Rodenrijs		
MON-GT-02	#2	2382	*	Rodenrijs		
MON-GT-02	#2	2383		Rodenrijs		
MON-GT-02	#2	2384		Rodenrijs		2384
MON-GT-02	#2	2385		Rodenrijs		
MON-GT-02	#2	2386		Rodenrijs		
MON-GT-02	#2	2387		Rodenrijs		2387
MON-GT-02	#2	2388		Rodenrijs		
MON-GT-02	#2	2389		Rodenrijs		
MON-GT-02	#2	2390		Rodenrijs		2390
MON-GT-02	#2	2391	*	Rodenrijs		
MON-GT-02	#2	2392		Rodenrijs		2392
MON-GT-02	#2	2393	*	Rodenrijs		
MON-GT-02	#2	2394	*	Rodenrijs		
MON-GT-02	#2	2395		Rodenrijs		
MON-GT-02	#2	2396	*	Rodenrijs		
MON-GT-02	#2	2397		Rodenrijs		2397
MON-GT-02	#2	2398	*	Rodenrijs		
MON-GT-02	#2	2399	*	Rodenrijs		
MON-GT-02	#2	2400		Rodenrijs		
MON-GT-02	#2	2401		Rodenrijs		
MON-GT-02	#2	2402		Rodenrijs		2402
MON-GT-02	#2	2403	*	Rodenrijs		
MON-GT-02	#2	2404	*	Rodenrijs		
MON-GT-02	#2	2405	*	Rodenrijs		
MON-GT-02	#2	2406		Rodenrijs		
MON-GT-02	#2	2407		Rodenrijs		
MON-GT-02	#2	2408		Rodenrijs		
MON-GT-02	#2	2409		Rodenrijs		
MON-GT-02	#2	2410		Rodenrijs		2410

2.3 Lithostratigraphy of the Lower Cretaceous from the West Netherlands Basin

The Rodenrijs Claystone Member is the uppermost member of the Nieuwerkerk Formation (Figure 2) that belongs to the predominant non-marine Schieland Group. The overlying Rijswijk Member belongs to the (marine) Vlieland Sandstone Formation of the Rijnland Group. A small erosional hiatus is generally assumed between these two units (Verreussel et al. in press).

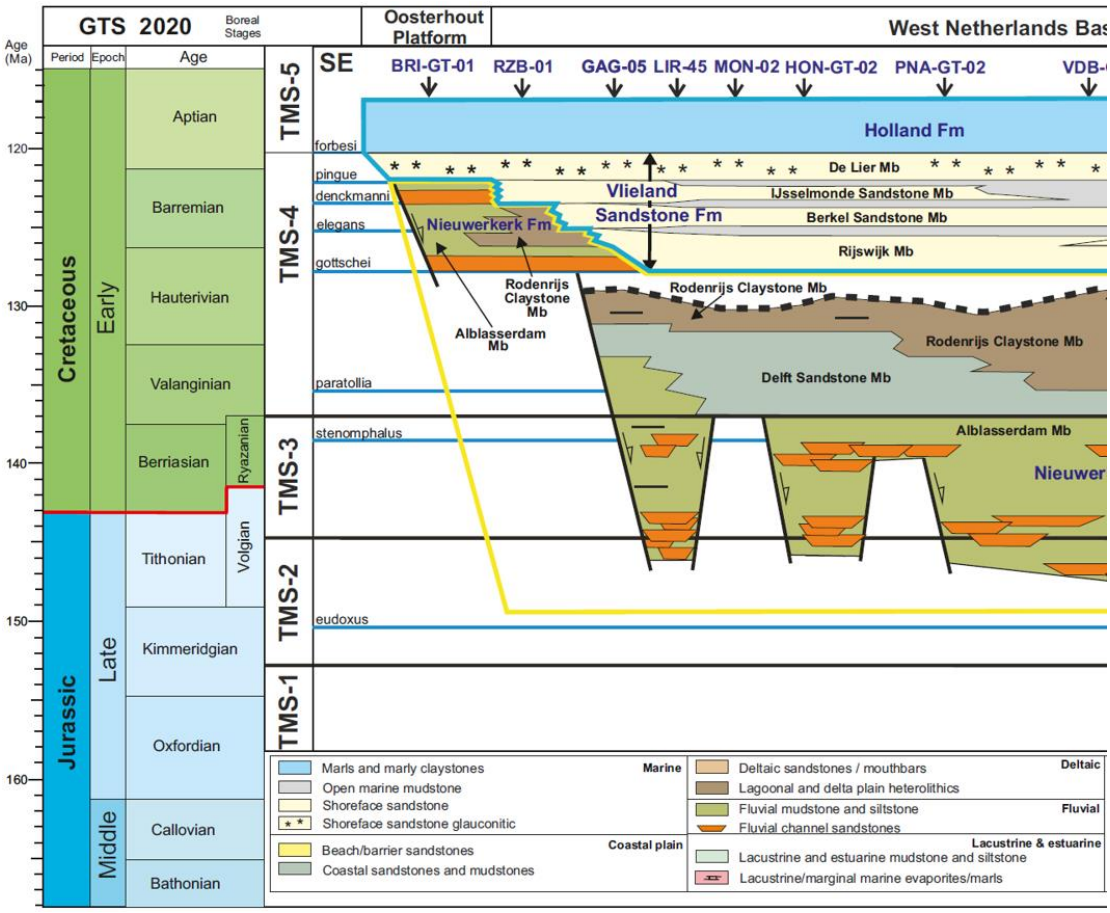


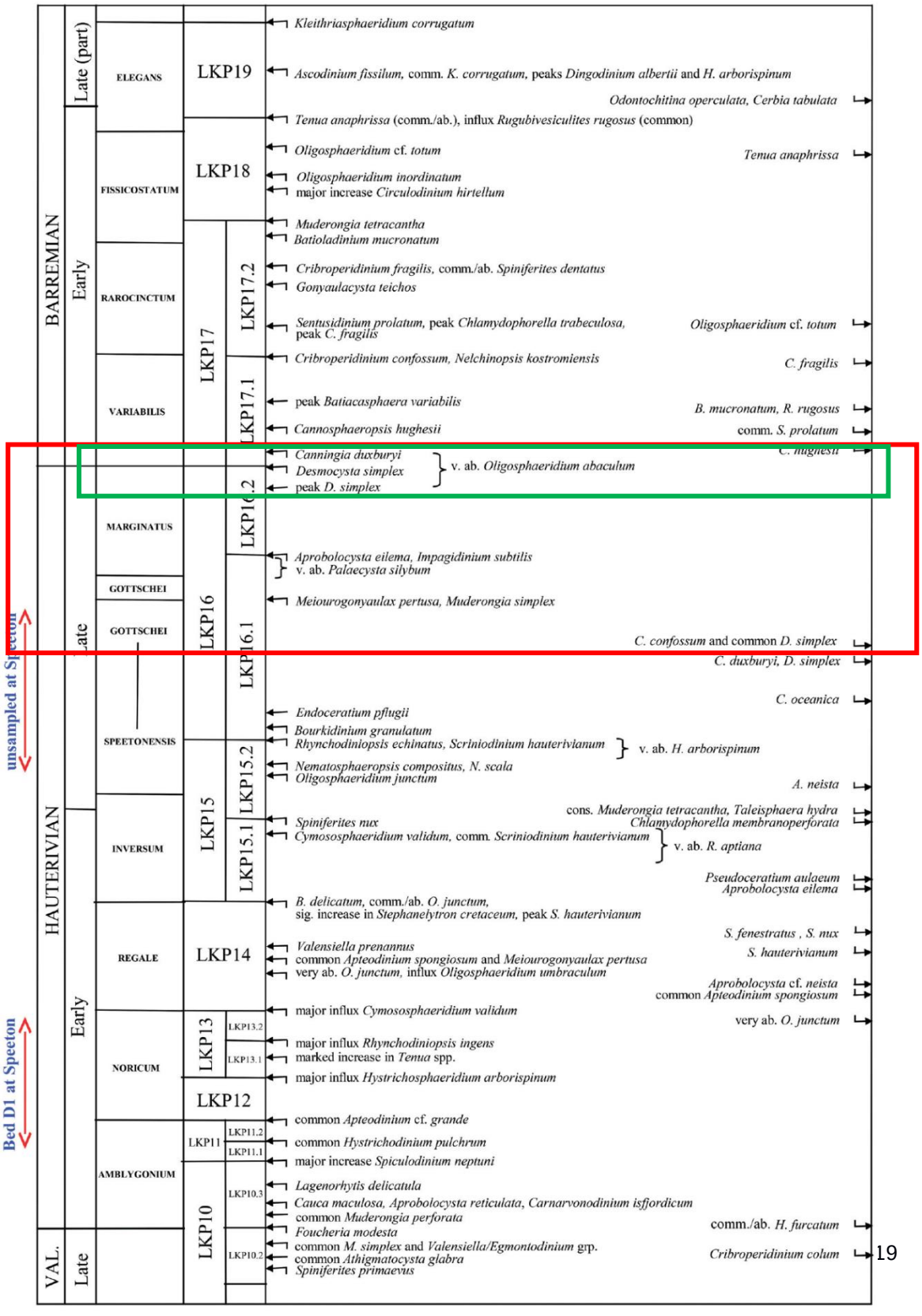
Figure 2 Lithostratigraphy of the Upper Jurassic-Lower Cretaceous from the West Netherlands Basin after Verreussel et al. (in press).

2.4 Methodology age assessment

Note that many palynological studies on the Nieuwerkerk Formation were published in reports (Munsterman 2012; 2015; 2017; 2018; 2019a; 2019b), but most of these were based on cuttings samples, which limits the accuracy of the age datings since only last occurrences (LOD's) of palynomorphs can be used.

For the age assessments, recent publications on the Valanginian to Barremian interval from Stan Duxbury proved to be most useful (Duxbury, 2018; 2019; 2023). His zonation for the Hauterivian – Barremian that was published in 2023 is included in this report (Figure 3).

Figure 3 Palynological zonal scheme for the Hauterivian-Barremian of the North Sea Region (Dubxbury, 2023). In red is indicated the age envelope for the studied interval, in green the most probable age interpretation.



2.5 Methodology paleoenvironmental interpretation

Palynologists study acid-resistant organic matter from sedimentary rocks. Organic matter is classified into palynomorphs (organic microfossils within a certain size range) and palynodebris (all other organic material such as plant-tissue, wood fragments, amorphous organic matter etc.). The combination of palynomorphs and palynodebris is called palynofacies or organofacies. Within the palynomorph category, two groups are considered the most important: the dinoflagellate cysts, or dinocysts, and the pollen and spores, or sporomorphs. Because palynology straddles both the marine and the terrestrial realm, it is ideally suited for the study of shallow- to non-marine sedimentary rocks. Palynomorphs and palynodebris are always subject to transport, the palynology-based depositional environment is therefore broader than the depositional setting such as derived from *in-situ* sedimentological, geochemical or paleontological features and parameters. The link between depositional setting and palynology-based depositional environment is display in Figure 3. A summary of the most relevant environmental interpretations based on palynology are listed below:

Open marine
Dominance of dinoflagellate cysts indicates open marine environments, in particular when the dinoflagellate cyst assemblages are highly diverse (many species).

Restricted marine
Dinoflagellate cyst associations of the type High Dominance – Low Diversity indicate a restricted marine environment, such as a lagoon, embayment or estuary.

Non-marine
Absence or near-absence of dinoflagellate cysts generally indicates non-marine or marginal marine environments.

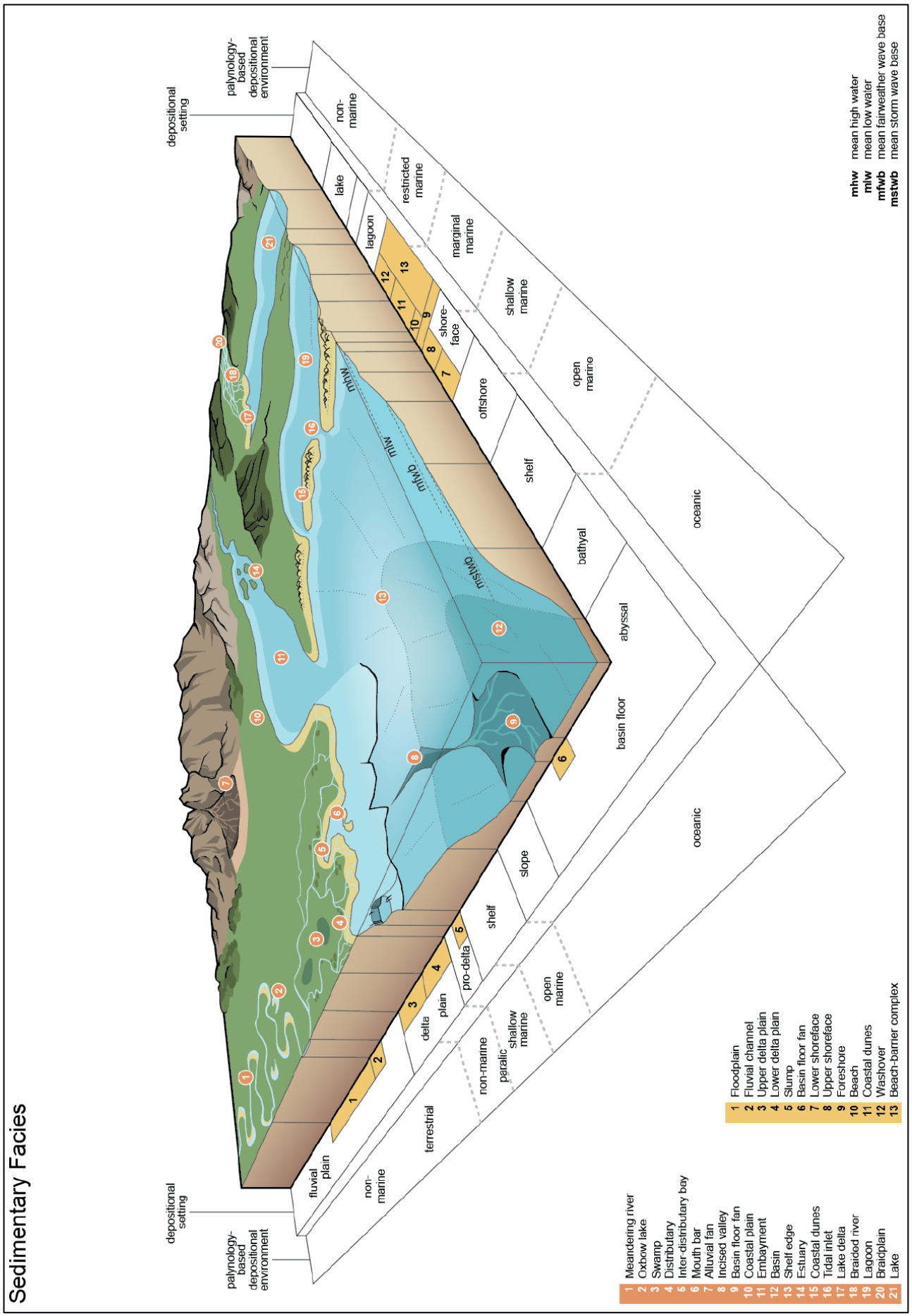
Transgression
An increase in the ratio between dinoflagellate cysts and pollen and spores indicates a sea level rise.

Regression
A decrease in the ratio between dinoflagellate cysts and pollen and spores indicates a sea level fall.

Low energy conditions
Excellent physical preservation of palynomorphs and other organic matter particles may indicate low energy conditions such as for instance a lagoon or a lake.

High energy conditions
Poor physical preservation of palynomorphs may indicate high energy conditions such as for instance a river channel, basin floor fan or a beach.

Figure 4 (next page) Depositional environments inferred from palynolgical analyses compared to depositional settings inferred from sedimentology.


Sedimentary Facies
depositional setting
palynology-based depositional environment
fluvial plain
non-marine
terrestrial
delta plain
pro-delta
shelf
slope
basin floor
abyssal
bathyal
oceanic
non-marine
peralic
shallow marine
open marine
lake
lagoon
restricted marine
marginal marine
shallow marine
shore-face
offshore
shelf
open marine
oceanic
non-marine
mhw
mlw
mfwb
mstwb
1 Meandering river
2 Oxbow lake
3 Swamp
4 Distributary
5 Inter-distributary bay
6 Mouth bar
7 Alluvial fan
8 Incised valley
9 Basin floor fan
10 Coastal plain
11 Embayment
12 Basin
13 Shelf edge
14 Estuary
15 Coastal dunes
16 Tidal inlet
17 Lake delta
18 Braided river
19 Lagoon
20 Braidplain
21 Lake
1 Floodplain
2 Fluvial channel
3 Upper delta plain
4 Lower delta plain
5 Slump
6 Basin floor fan
7 Lower shoreface
8 Upper shoreface
9 Foreshore
10 Beach
11 Coastal dunes
12 Washover
13 Beach-barrier complex
mean high water
mean low water
mean fairweather wave base
mean storm wave base

3 Results

The palynological recovery of the studied samples varies substantially. The uppermost samples from the Rijswijk Member are very poor, whereas the samples from the interval 2387m – 2364m are very rich. The palynological recovery of the samples from the interval 2402m – 2390m is quite poor. The preservation of the palynomorphs is in general quite reasonable. The organofacies (all organic matter) is characterized by a balanced mixture of wood fragments, dinoflagellate cysts and sporomorphs (pollen and spores).

Based on the results of the palynological analyses, a threefold subdivision was established for the studied interval.

Nine photo-plates with micro-photographs of palynomorphs and organofacies are added as Appendix 1. Palynological distribution charts are added as Appendices 2a, 2b and 2c.

3.1 Description of the palynological results

Unit A 2410m – 2384m 7 CORE samples

Sporomorphs dominate over dinoflagellate cysts in the lower part of Unit A but this changes abruptly towards the top of the unit (Appendix 2a). Samples 2387m – 2384m from the top of Unit A yield very rich dinoflagellate cyst assemblages. The dinoflagellate cyst assemblages are dominated by *Cribroperidium* (Appendix 2b). The supposed freshwater-tolerant type *Vesperopsis* sp. A is common throughout the entire interval. The sporomorph assemblages are characterized mainly by bisaccate pollen and psilatrilete spores (Appendix 2c). *Cicatricosisporites* and *Gleicheniidites* are common in sample 2402m. Reworked spores from the Paleozoic occur regularly.

The organofacies is characterized by balanced mix between wood fragments and palynomorphs (Appendix 1, Plate 8). The wood fragments are in the same size range as the palynomorphs. Amorphous organic matter is absent.

Unit B 2379m – 2359m 6 CORE samples

Dinoflagellate cysts dominate over sporomorphs and the brackish water green algae *Botryococcus* is common in almost every sample (Appendix 2a). The dinoflagellate cyst assemblages are dominated by *Subtilisphaera,* while *Oligosphaeridium perforatum* ssp. *perforatum* is common throughout the entire interval (Appendix 2b). The sporomorph assemblages are dominated by bisaccate pollen and psilatrilete spores (Appendix 2c). Reworked spores from the Paleozoic were not encountered.

The organofacies is characterized by balanced mix between wood fragments and palynomorphs (Appendix 1, Plate 8). The wood fragments are bigger in size than the palynomorphs. Amorphous organic matter is absent.

Unit C 2354m – 2350.5m 2 CORE samples

Sample 2354m is very poor in palynomorphs, sample 2354m is completely barren. The overall state of preservation of the palynomorphs is poor.

The organofacies of this unit is characterized by small opaque particles (Appendix 1, Plate 8). Traces of oil emerged during the processing of the samples.

3.2 Age interpretation

Based on the events listed below, a Late Hauterivian to earliest Barremian age is inferred for the cored units A and B with a high degree of confidence.

Age-diagnostic dinocyst events:

- FOD and LOD *Canningia duxburyi ,* in sample 2410mCORE
- FOD *Oligosphaeridium perforatum* ssp. *perforatum,* in sample 2410mCORE
- FOD *Cribroperidinium confossum,* in sample 2367mCORE
- LOD *Muderongia simplex,* in sample 2410mCORE
- FOD *Subtilisphaera terrula,* in sample 2379mCORE

Age-diagnostic sporomorph events:

- FOD *Aequitriradites tilchaensis*, in sample 2392mCORE
- FOD *Aequitriradites spinulosus* in sample 2372mCORE
- Continuous presence of *Pilosisporites trichopapillosus*
- Complete absence of *Classopollis*

Tthe LOD of the widespread accepted marker species *Canningia duxburyi* in sample 2410m indicates an age older than earliest Barremian. Duxbury (2023) recorded the youngest occurrence of *Canningia duxburyi* just above the base of the Barremian Stage. In his zonation, this event is near the base of Zone LKP17. The FODs of *Canningia duxburyi* and *Cribroperidinium confossum* are in the Late Hauterivian, in the middle of Duxbury's palynofloral Zone LKP16.1, correlating to the Gottschei ammonite Zone. The FOD consistent of *Subtilisphaera terrula* is in bed C4C in Speeton, correlating to the Late Hauterivian Gottschei ammonite Zone. Therefore, a Late Hauterivian to earliest Barremian age is inferred for the cored units A and B with a high degree of confidence (indicated with a red box in Figure 3). The age-diagnostic sporomorphs are in agreement with this age interpretation.

Possibly, the age range may be narrowed down to latest Hauterivian to earliest Barremian based on the FOD of *Oligosphaeridium perforatum* ssp. *perforatum.* (indicated with a green box in Figure 3). The FOD of this type was recorded in Speeton is in Bed C2D, correlating to the top of the Marginatus ammonite Zone, very close to the Hauterivian – Barremian boundary (Duxbury, 2023).

Note that several markers that were expected, such as *Aprobolocysta eilema* and *Desmocyst plekta* were not recorded in the cored interval. Possibly, this is related to the rather restricted marine facies that characterize the Rodenrijs Claystone Member (see section 3.3).

3.3 Paleoenvironmental interpretation

Unit A
The dominance of sporomorphs over dinoflagellate cysts, in combination with the observed reworking and in combination with the common occurrence of freshwater dinocysts, indicates **a marginal marine environment** with strong terrestrial influence, possibly a deltaic setting. The sudden dominance of dinoflagellate cysts in the sample at 2387m indicates a marine flooding event.

Unit B
The dominance of dinoflagellate cysts over sporomorphs indicates a decrease in terrestrial influence, compared to Unit A. The sudden dominance of the dinflagellate cyst *Subtilisphaera* , in combination with common occurrences of the brackish-water green algae *Botryococcus,* indicates a restricted marine environment, i.e., a nutrient-rich embayment with a poor connectivity to the open sea.

Unit C
The small rounded particles and poor preservation are in line with a high energy environment, such as e.g. an upper shoreface. Note however that any palaeoenvironmental interpretation will be tentative at best, due to the poor preservation and the lack of diagnostic palynomorphs.

3.4 The base of the Rijswijk Mb

The lithostratigraphy that was provided by the operator place the base of the Rijswijk Member at the shift in GR that occurs at 2365mMD. The shift likely reflects a transition from fine-grained dominated sediments to sandstones. The palynological results (Appendix 2a and 2b and particularly the distribution chart of the dinoflagellate cysts do not display a significant change at that depth (2365m). In fact, the palynological record shows a distinct change in palaeoenvironment between sample 2359m and 2354m, the boundary between palynological unit B and C. As a consequence, it seems more logical, at least from a paleoenvironmental perspective, to place the base of the Rijswijk Member at approximately 2357m (see Figure 5).

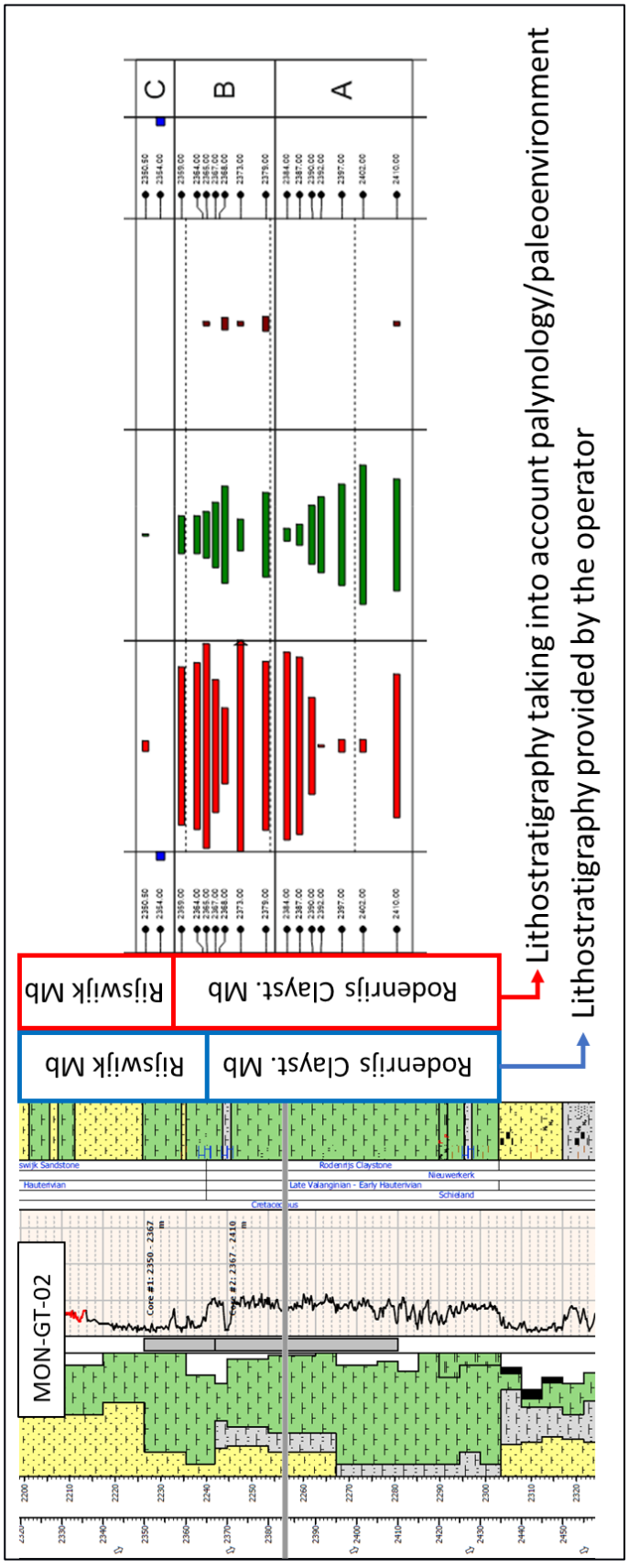


Figure 5 The base of the Rijswijk Mb as provided by the operator versus the base of the Rijswijk Mb taking into account the depositional setting.

3.5 Comparison with nearby well HON-GT-01

A comparison of Well MON-GT-02 with the nearby well HON-GT-01 shows a strong similarity in the overall thicknesses and in the GR trends of the Rijwijk and Rodenrijs Claystone members (Figure 6). The marine flooding that was observed close to the top of Unit A at 2387m in well MON-GT-02, possibly correlates to a change in the sonic log at 2505mMD in well HON-GT-01.

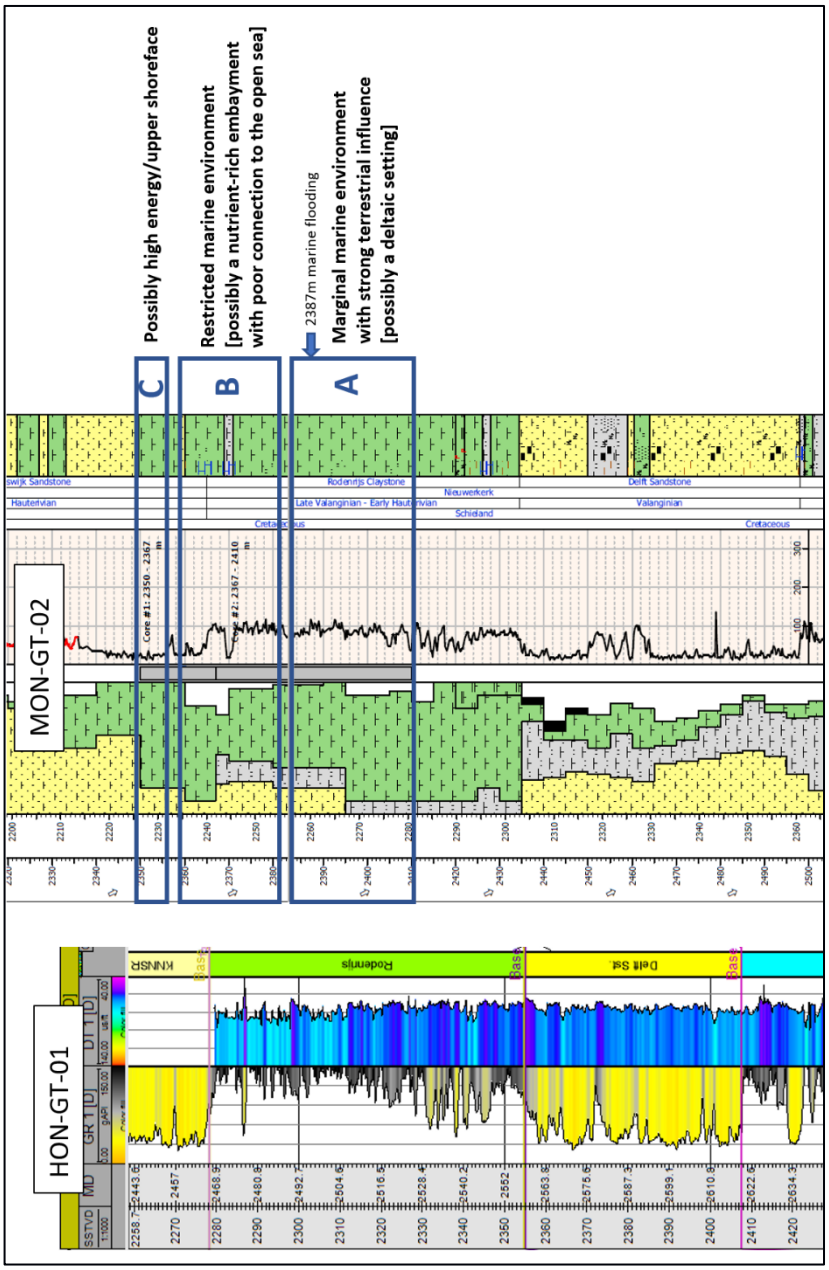


Figure 6 Comparison of well MON-GT-02 with nearly well HON-GT-01

4 Conclusions

Based on the palynological analyses of the cored interval 2350m – 2410m from well MON-GT-02, the following conclusions are reached:

- The age of the Rodenrijs Claystone interval is Late Hauterivian to earliest Barremian with a high degree of confidence. Possibly, the age may be narrowed down to latest Hauterivian to earliest Barremian.
- The lower part of the cored Rodenrijs Claystone interval (2410m – 2384m) displays a marginal marine palaeoenvironment with strong terrestrial influence, possibly reflecting a deltaic setting. A marine flooding is postulated at 2387m.
- The upper part of the cored Rodenrijs Claystone interval (2379m – 2359m) displays a restricted marine palaeoenvironment, possibly reflecting a nutrient-rich embayment with a poor connection to the open sea.
- From a paleoenvironmental perspective, it is preferred to draw the base of the Rijswijk Member at approximately 2357m

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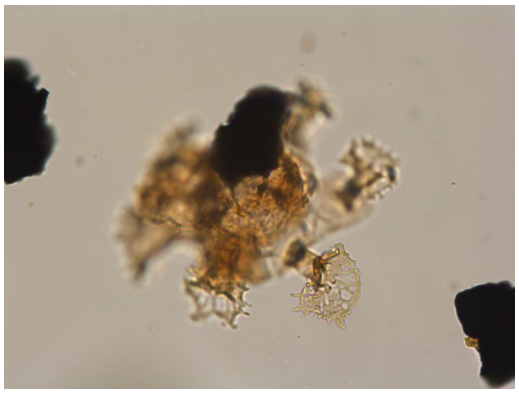
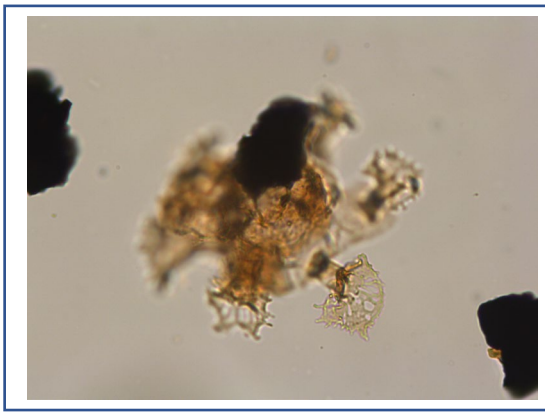
Appendix 1

Photoplates

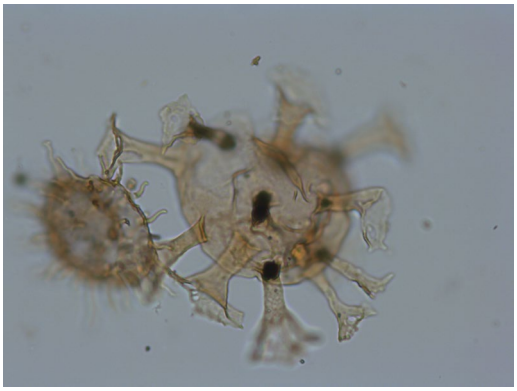
Plate 1



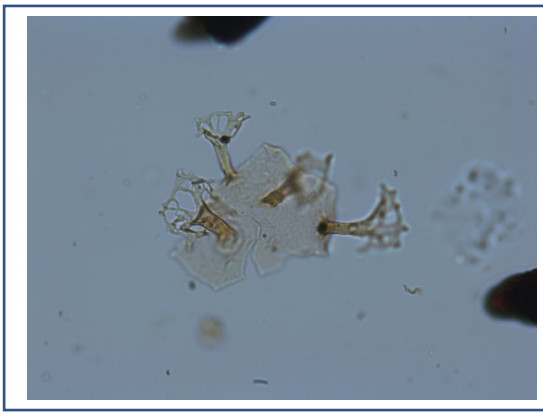
Oligosphaeridium perforatum ssp. *perforatum*
MON-GT-02 2410mCORE
40x



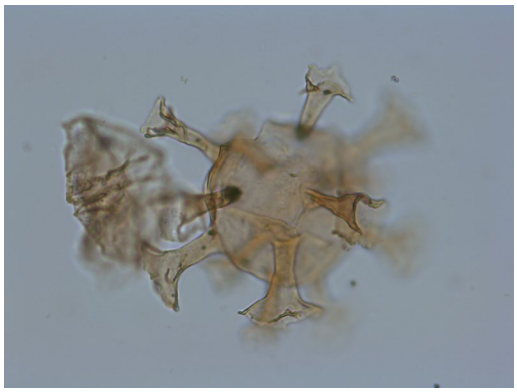
Oligosphaeridium perforatum ssp. *perforatum*
MON-GT-02 2410mCORE
40x



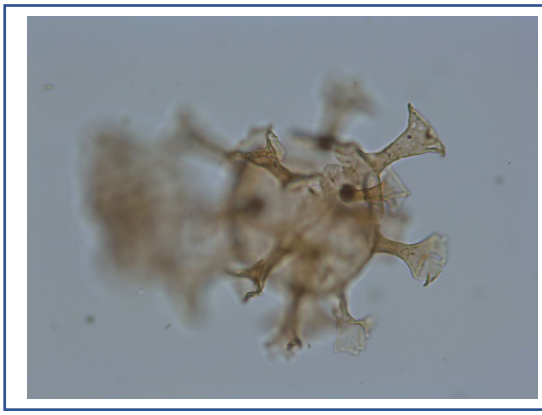
Oligosphaeridium perforatum ssp. *perforatum*
MON-GT-02 2365mCORE
40x



Oligosphaeridium perforatum ssp. *perforatum*
MON-GT-02 2365mCORE
40x Operculum 4 apical plates

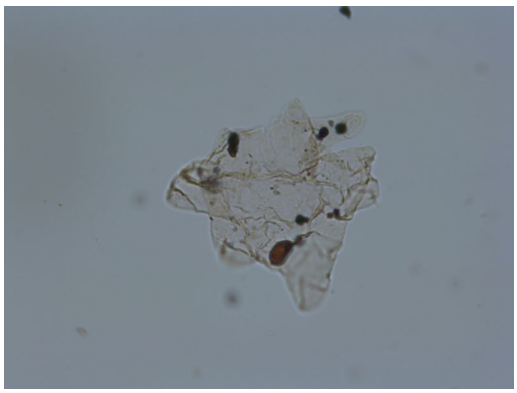


Oligosphaeridium perforatum ssp. *perforatum*
MON-GT-02 2367mCORE
40x UF

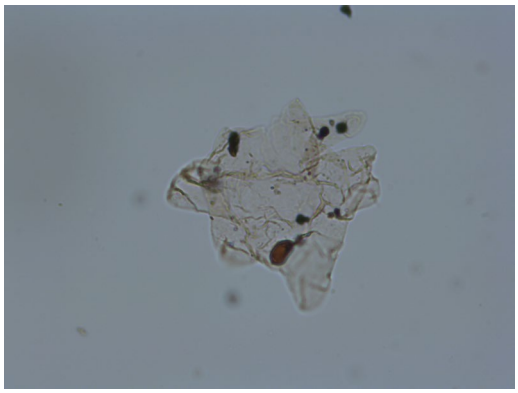


Oligosphaeridium perforatum ssp. *perforatum*
MON-GT-02 2367mCORE
40x LF

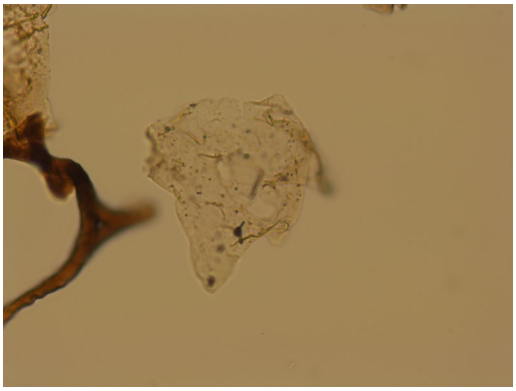
Plate 2



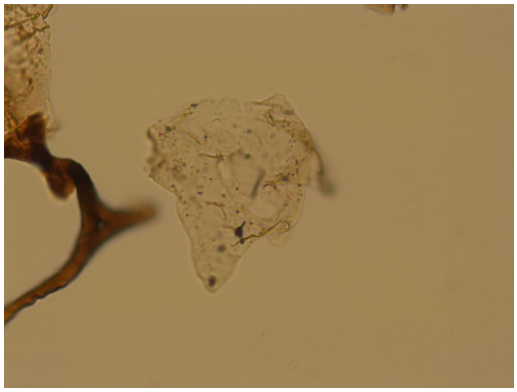
Vesperopsis sp. A
MON-GT-02 2410mCORE
40x UF ventral



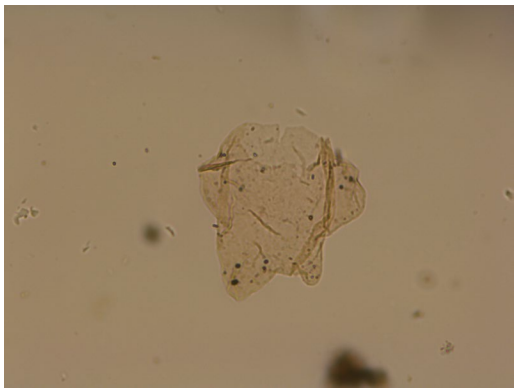
Vesperopsis sp. A
MON-GT-02 2410mCORE
40x MF Note the apical archeopyle



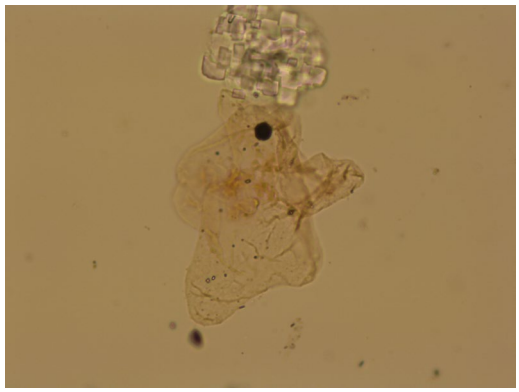
Vesperopsis sp. A
MON-GT-02 2384mCORE
40x UF dorsal



Vesperopsis sp. A
MON-GT-02 2384mCORE
40x LFF ventral

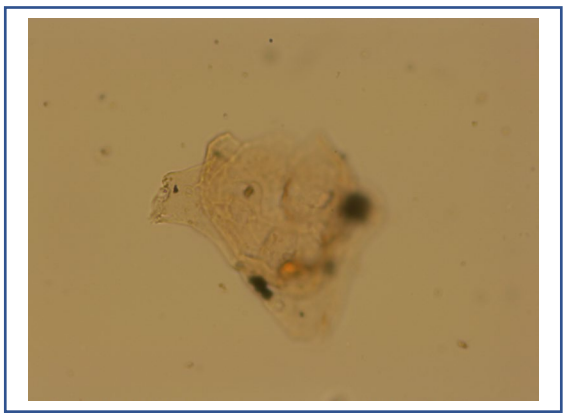


Vesperopsis sp. A
MON-GT-02 2390mCORE
40x

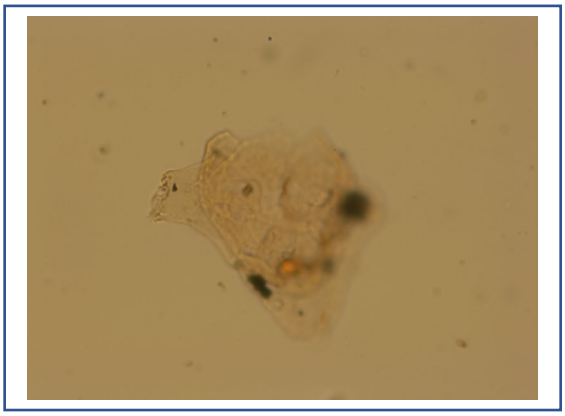


Vesperopsis sp. A
MON-GT-02 2379mCORE
40x

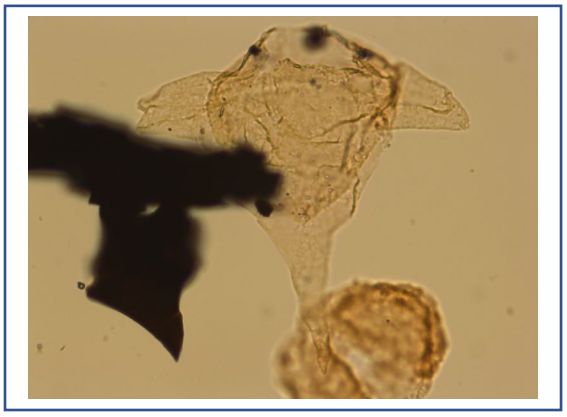
Plate 3



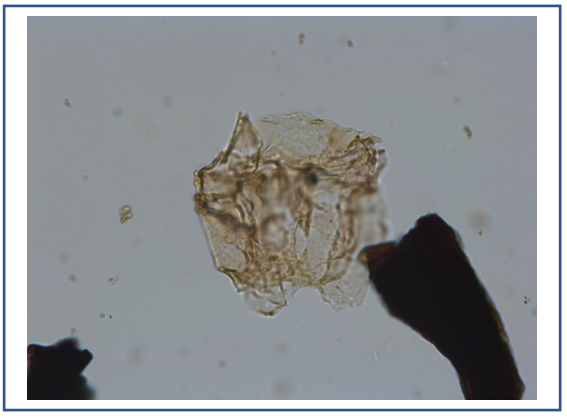
Muderongia perforata
MON-GT-02 2379mCORE
40x UF



Muderongia perforata
MON-GT-02 2379mCORE
40x LF



Muderongia simplex
MON-GT-02 2379mCORE
40x LF ventral

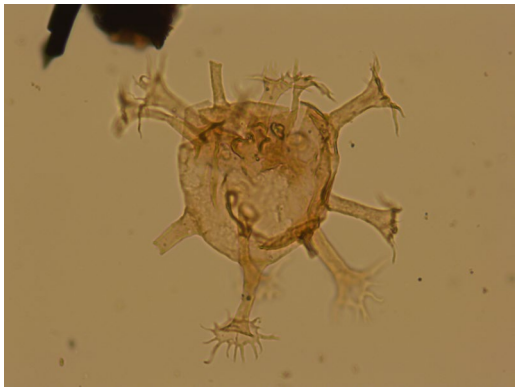


Senoniasphaera sp.
MON-GT-02 2365mCORE
40x

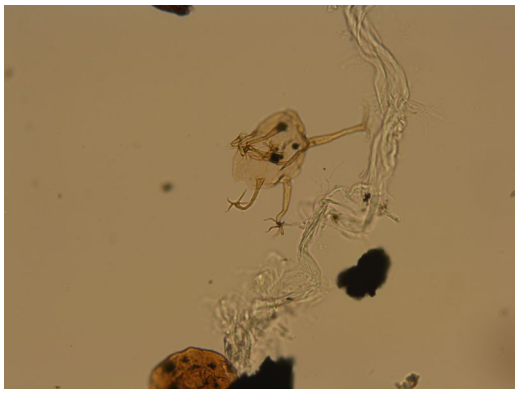
Pseudoceratium solocispinum
MON-GT-02 2387mCORE
40x

Ctenidodinium elegantulum
MON-GT-02 2387mCORE
40x

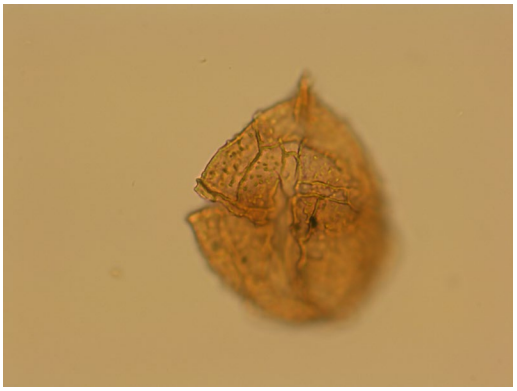
Plate 4



Oligosphaeridium complex
MON-GT-02 2379mCORE
40x

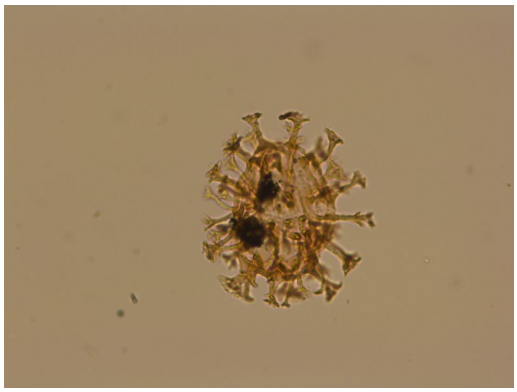


Oligosphaeridium asterigerum
MON-GT-02 2387mCORE
40x

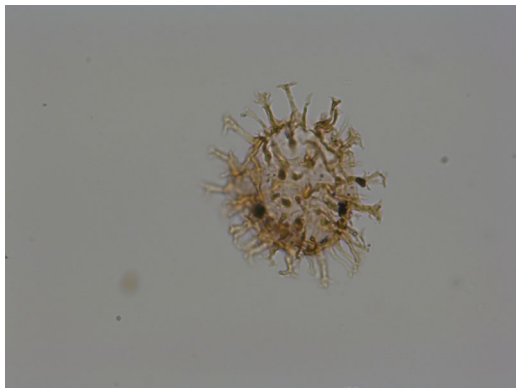


Cribroperidinium sp.
MON-GT-02 2387mCORE
40x UF ventral

Cribroperidinium sp.
MON-GT-02 2387mCORE
40x LF dorsal

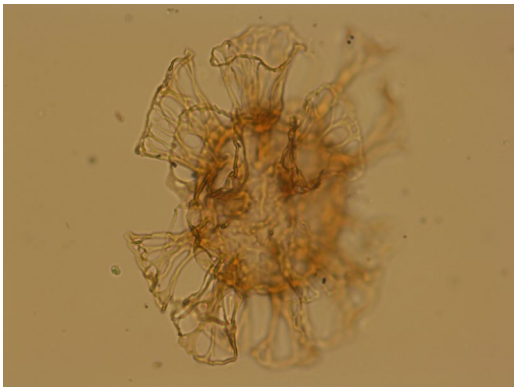


Taleisphaera/Kiokansium cpx.
MON-GT-02 2390mCORE
40x

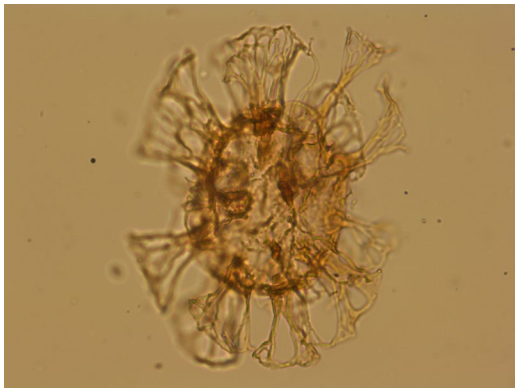


Taleisphaera/Kiokansium cpx.
MON-GT-02 2410mCORE
40x

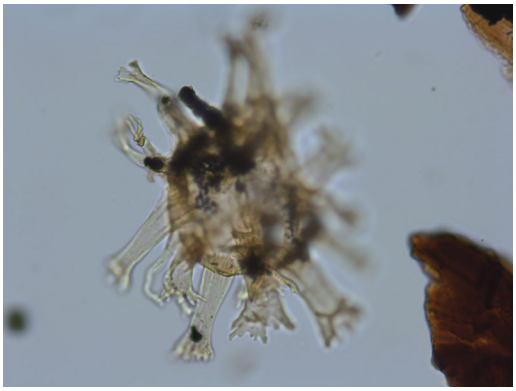
Plate 5



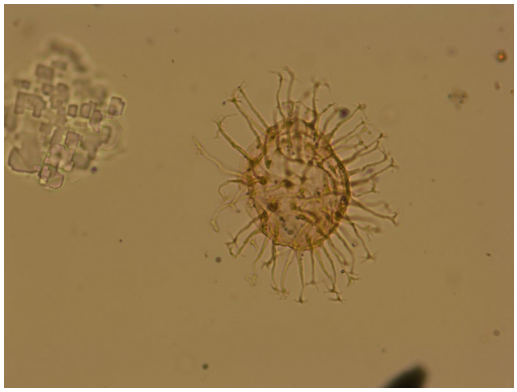
Hystrichosphaerina schindewolfii
MON-GT-02 2379mCORE
40x UF



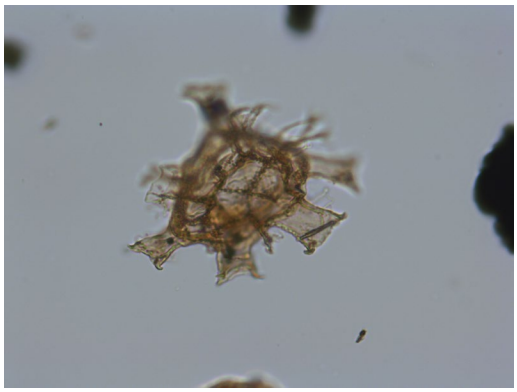
Hystrichosphaerina schindewolfii
MON-GT-02 2379mCORE
40x LF



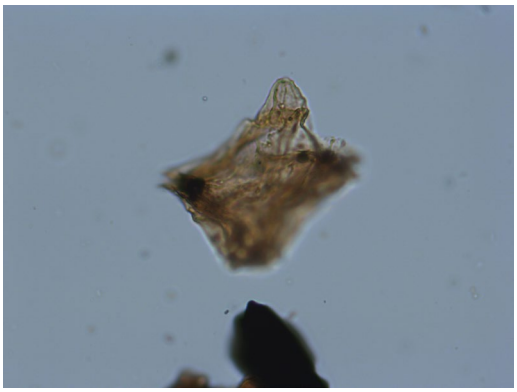
Kleithriasphaeridium corrugatum
MON-GT-02 2367mCORE
40x



Impletosphaeridium multifurcillatum
MON-GT-02 2379mCORE
40x

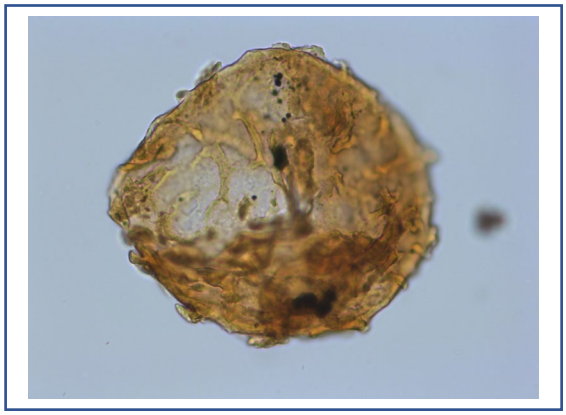


Callaiosphaeridium asymetricum
MON-GT-02 2367mCORE
40x

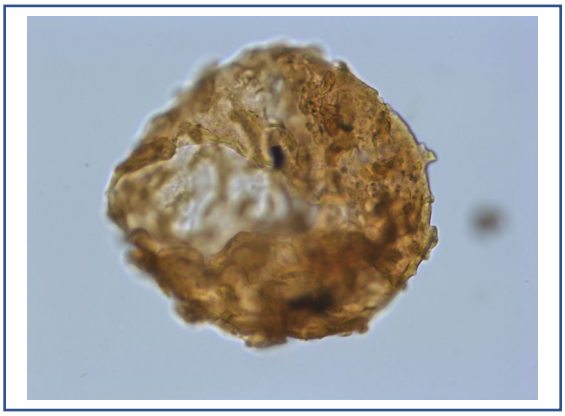


Occisucysta duxburyi
MON-GT-02 2365mCORE
40x

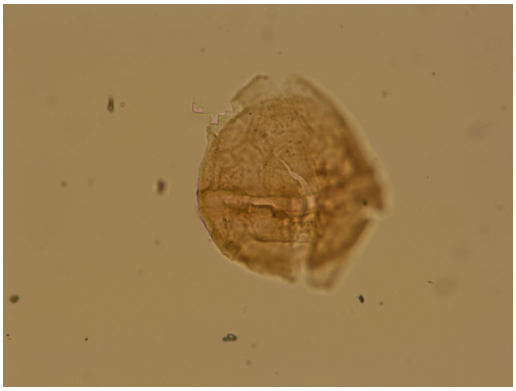
Plate 6



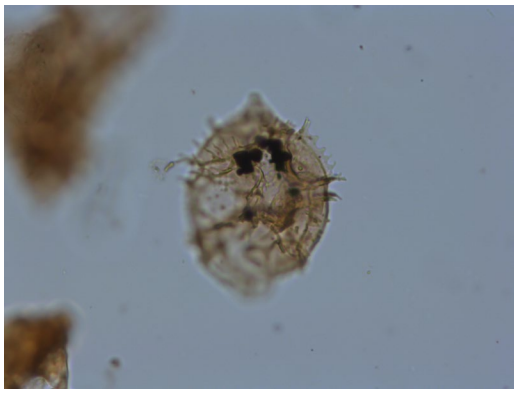
Cassiculosphaeridia magna
MON-GT-02 2367mCORE
40x UF



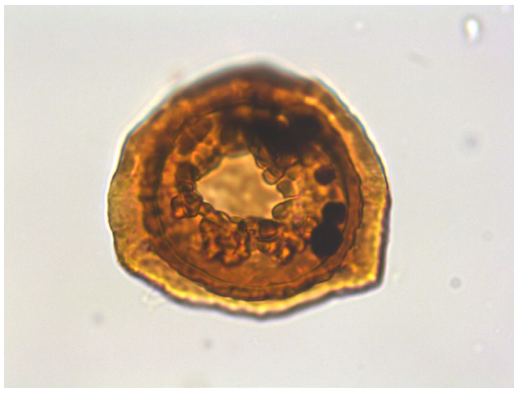
Cassiculosphaeridia magna
MON-GT-02 2367mCORE
40x LF



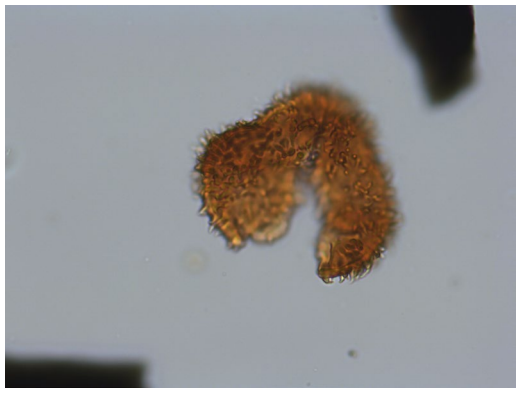
Subtilisphaera terrula
MON-GT-02 2379mCORE
40x



Wrevittia helicoidea
MON-GT-02 2365mCORE
40x

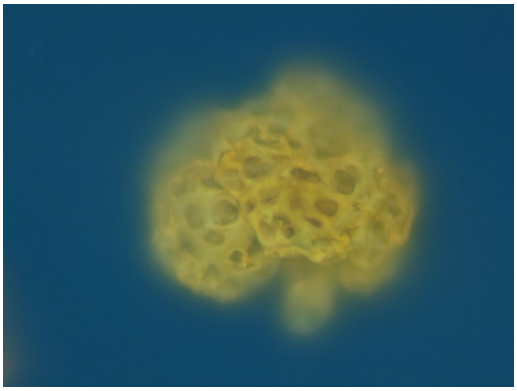


Aequitriradites tilchaensis
MON-GT-02 2392mCORE
63x

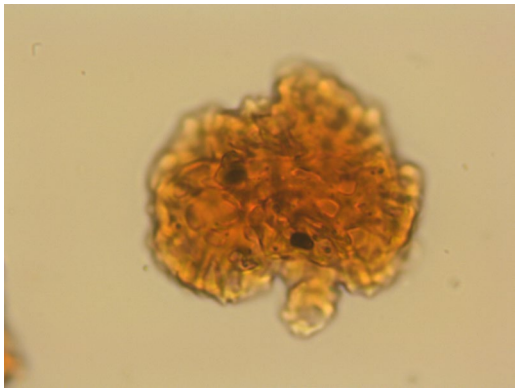


Pilosisporites trichopapillosus
MON-GT-02 2368mCORE
40x

Plate 7

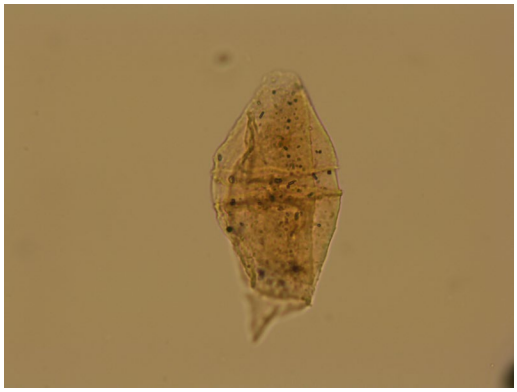


Botryococcus
MON-GT-02 2379mCORE
63x incident Ultra-Violet light

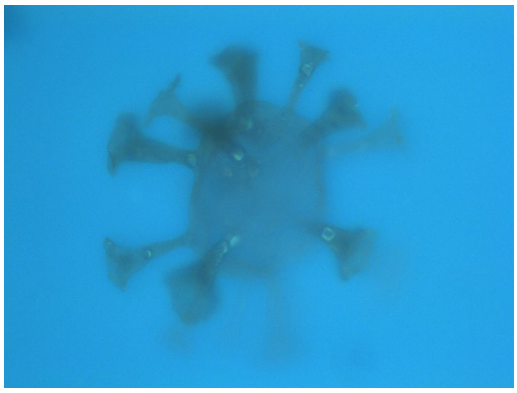


Botryococcus
MON-GT-02 2379mCORE
63x

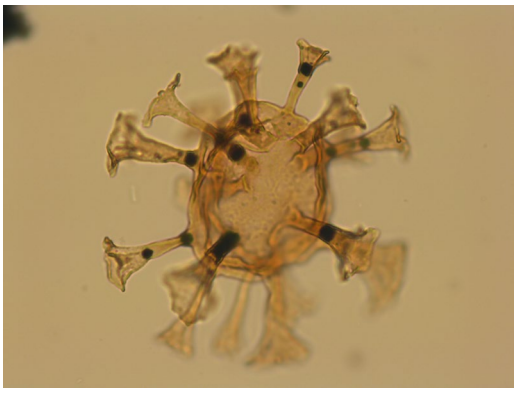
Subtilisphaera perlucida
MON-GT-02 2379mCORE
40x incident Ultra-Violet light



Subtilisphaera perlucida
MON-GT-02 2379mCORE
40x

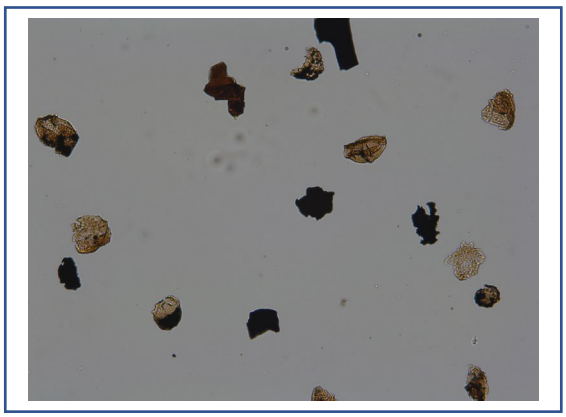


Oligosphaeridium perforatum ssp. *perforatum*
MON-GT-02 2379mCORE
40x incident Ultra-Violet light

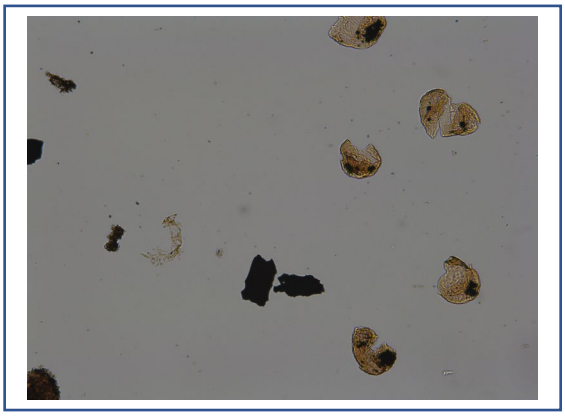


Oligosphaeridium perforatum ssp. *perforatum*
MON-GT-02 2379mCORE
40x

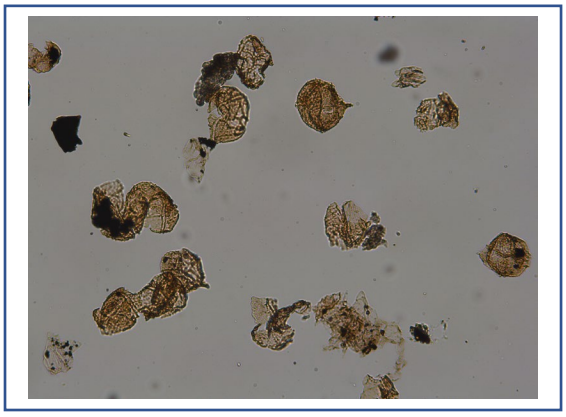
Plate 8



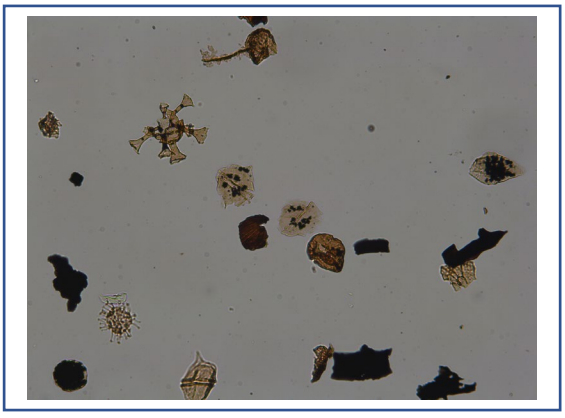
Palynofacies overview with 10x objective
MON-GT-02 2410mCORE
Rodenrijs Claystone Mb of the Nieuwerkerk Fm



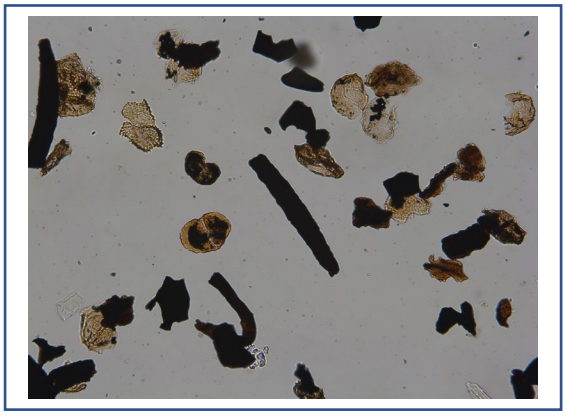
Palynofacies overview with 10x objective
MON-GT-02 2392mCORE
Rodenrijs Claystone Mb of the Nieuwerkerk Fm



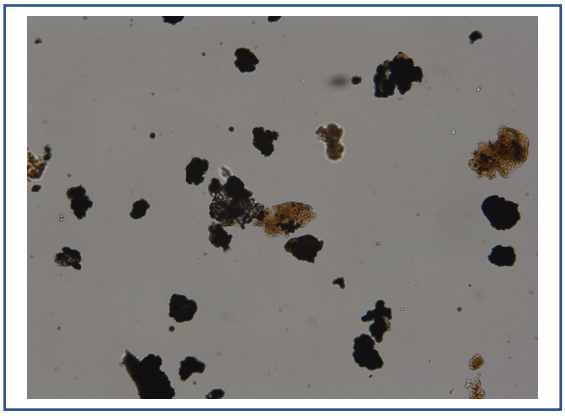
Palynofacies overview with with 10x objective
MON-GT-02 2384mCORE
Rodenrijs Claystone Mb of the Nieuwerkerk Fm



Palynofacies overview with 10x objective
MON-GT-02 2373mCORE
Rodenrijs Claystone Mb of the Nieuwerkerk Fm

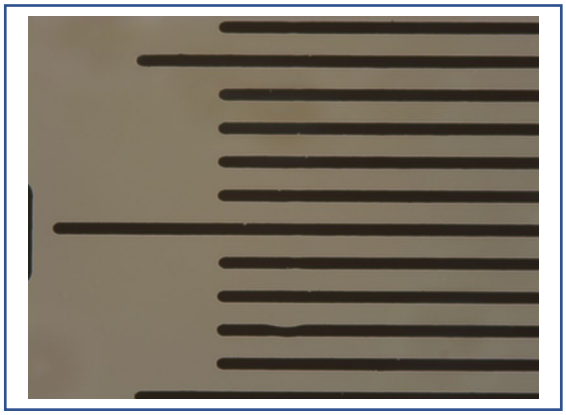


Palynofacies overview with 10x objective
MON-GT-02 2365mCORE
Rodenrijs Claystone Mb of the Nieuwerkerk Fm

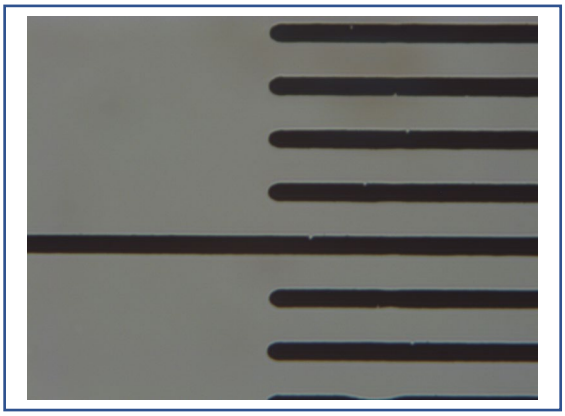


Palynofacies overview with 10x objective
MON-GT-02 2350mCORE + 2351mCORE
Rijswijk Mb of the Vlieland Sandstone Fm

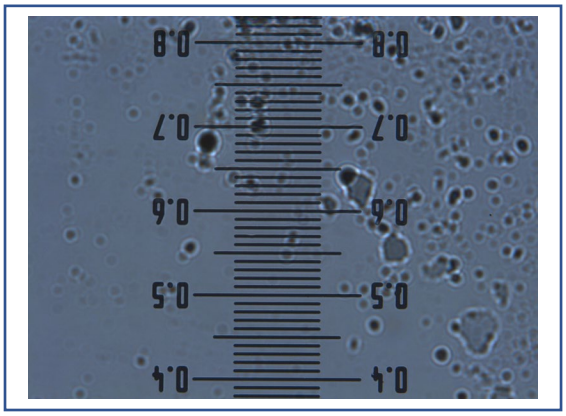
Plate 9



Micrometer scale with 40x objective
1 bar = 10µ



Micrometer scale with 63x objective
1 bar = 10µ



Micrometer scale with 10x objective
1 bar = 10µ

TNO report 2024 R10047

Appendix 2

Palynological distribution charts

Well Name : Monster-GT-02

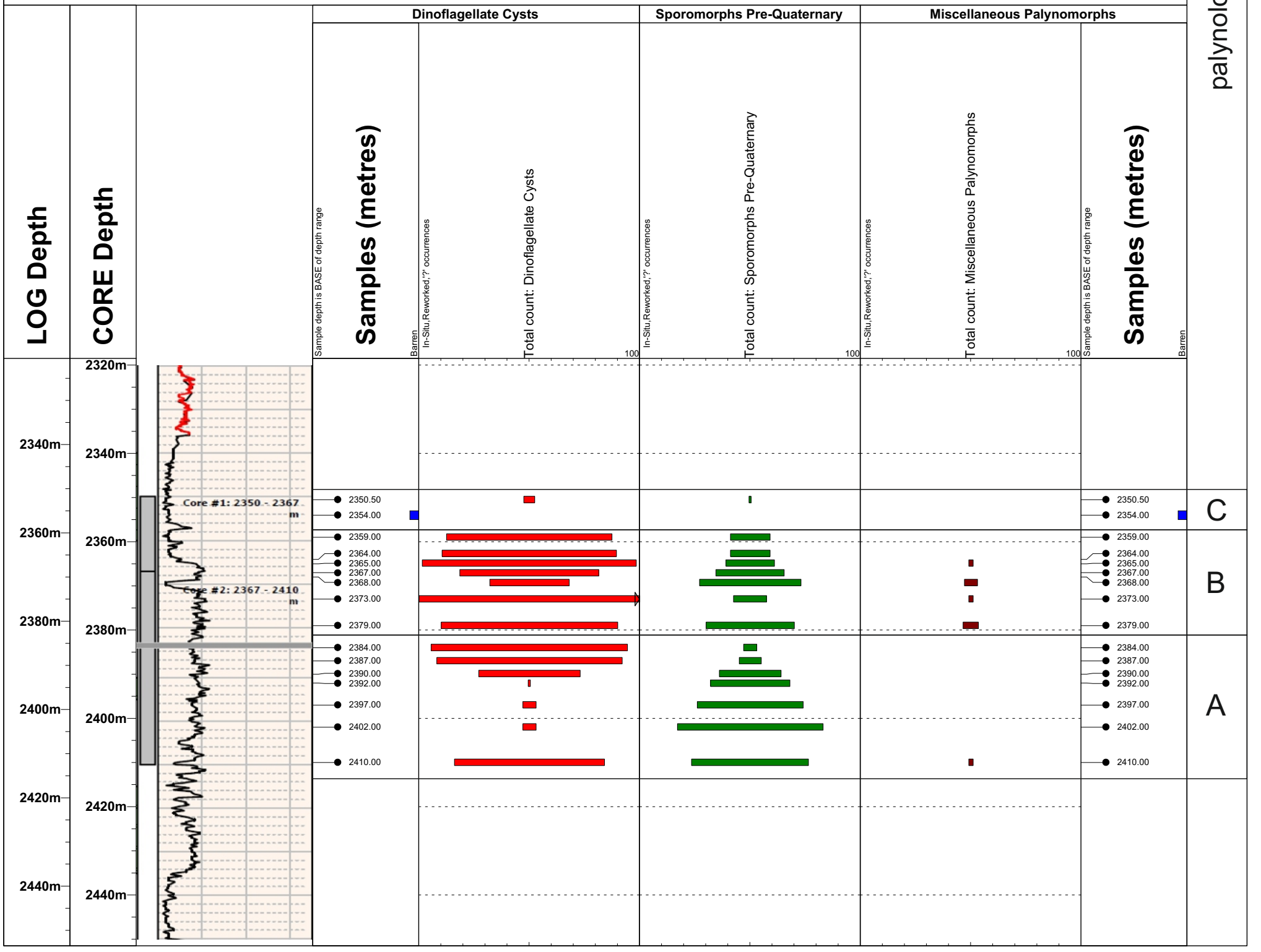
Interval Various
Scale : 1:1000
TNO report 2024 R10047

Palynological distribution chart
Marine-terrestrial
Roel Verreussel

MON-GT-02

TNO
Utrecht

Appendix 2a



Well Name : Monster-GT-02

Interval Various
Scale : 1:1000
TNO report 2024 R10047

Palynological distribution chart
Dinoflagellate cysts
Roel Verreussel

MON-GT-02

TNO
Utrecht

Appendix 2b

Dinoflagellate Cysts

Absolute abundance (50mm=100 counts)
In-Situ,Reworked,'?' occurrences

Log Depth | CORE Depth | Core #1: 2350 - 2367 m | Core #2: 2367 - 2410 m

Sample depth is BASE of depth range | Samples (metres) | Barren

Apteodinium cf. granulatum
Batioladinium jaegeri
Callaiosphaeridium asymmetricum
Canningia duxburyi
Cassiculosphaeridia magna
Cauca rigidum
Cribroperidinium brevispinum
Cribroperidinium confossum
Cribroperidinium spp.
Ctenidodinium elegantulum
Heslertonia heslertonensis
Hystrichodinium pulchrum
Hystrichosphaeridium petilum
Hystrichosphaerina schindewolfii
Impletosphaeridium multifurcillatum
Kleithriasphaeridium corrugatum
Kleithriasphaeridium eoinodes
Meiourogonyaulax stoveri
Muderongia perforata
Muderongia simplex
Occisucysta duxburyi
Oligosphaeridium asterigerum
Oligosphaeridium complex
Oligosphaeridium perforatum
Oligosphaeridium pulcherrimum
Phoberocysta neocomica
Pseudoceratium pelliferum
Pseudoceratium solocispinum
Senoniasphaera spp.
Sirmiodinium grossii
Spiniferites dentatus
Subtilisphaera perlucida
Subtilisphaera terrula
Taleisphaera/Kiokansium cpx.
Tenua/Circulodinium cpx.
Trichodinium speetonensis
Vesperopsis sp. A
Vexillocysta spinosa
Wrevittia helicoidea

Sample depth is BASE of depth range | Samples (metres) | Barren

palynological unit

Log Depth	Samples (metres)	palynological unit
2320m	2350.50	C
2340m	2354.00	
	2359.00	B
2360m	2364.00	
	2365.00	
	2367.00	
	2368.00	
2380m	2373.00	
	2379.00	
	2384.00	A
2400m	2387.00	
	2390.00	
	2392.00	
	2397.00	
	2402.00	
2420m	2410.00	
2440m		

Well Name : Monster-GT-02

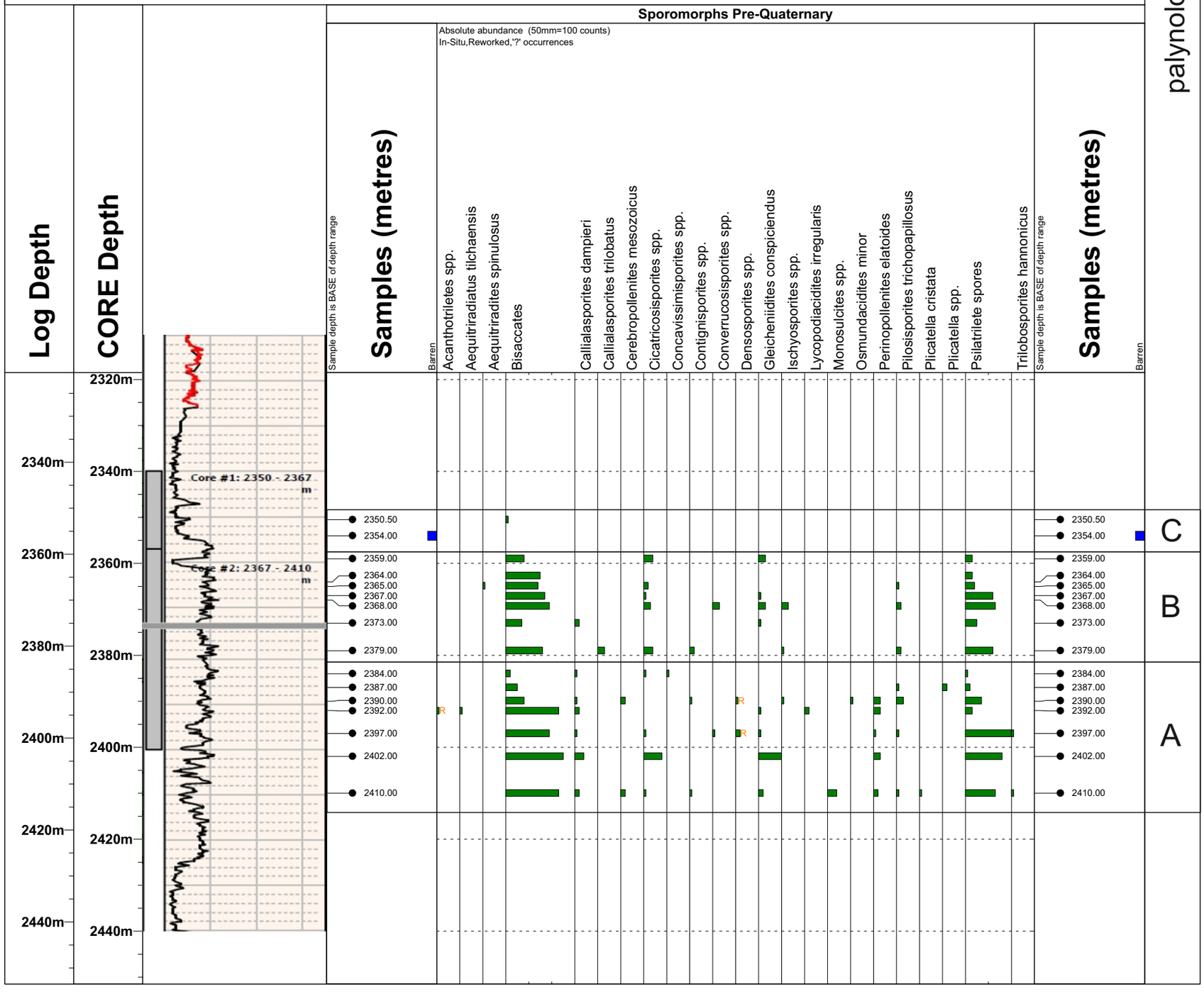
Interval Various
Scale : 1:1000
TNO report 2024 R10047

Palynological distribution chart
Sporomorphs
Roel Verreussel

MON-GT-02

TNO
Utrecht

Appendix 2c



Energy & Materials Transition

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