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SINE-1X

Palynological biostratigraphy of the Sine-1x
exploration well in the Danish North Sea

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Contents

Introduction	3
Laboratory	3
Analysed material	4
Biostratigraphical results.....	6

Introduction

This is a brief report of the palynological biostratigraphical work from the 24th of August to the 5th of September, 1998 at Mærsk Exerter during the drilling of the SINE-1x well in the southern Danish North Sea (Fig. 1).

The SINE-1x well was planned to penetrate the Upper Cretaceous chalk into clastic sediments of unpredicted age. In the case of overpressured sediments of mid-Jurassic age below the chalk, casing had to be set at the base of the chalk, and it was therefore important to discriminate Jurassic sediments from older strata. Age determinations based on organic microfossils (spores, pollen and dinoflagellate cysts) in siliciclastic sediments are generally very precise. Spores and pollen are especially applicable in terrestrial environments (i.e. Middle Jurassic in the North Sea) where all marine fossils are absent.

Biostratigraphy based on organic microfossils (palynology) requires preparation of the sediment sample with hydrofluoric acid (HF) to remove silica minerals and with hydrochloric acid (HCl) to remove carbonates. HF and HCl are necessary to prepare both siliciclastic and calcareous rocks due to their supplementary content of carbonate or clay minerals, respectively. A laboratory for palynological preparation was therefore established in a Mærsk transport container placed on the deck of the rig outside the "gas protection area". Mærsk Oil and Gas rented and installed a Portable Palynological Processing Cabinet (PPPC) from the company TimeTrax, established light facilities, fire-extinguisher and a sink with drain. GEUS supplied laboratory equipment; glass and polypropylene containers, ultrasonic bath, centrifuge, filter system, pollen microscope and other necessary laboratory accessories e.g. lab. safety equipment. The laboratory was manned with an experienced lab-technician to minimise both preparation time and hazards of acid handling.

The lab-equipment and microscope were sent in advance to Mærsk Directional Drilling in Esbjerg. During a 2 days safety course, the PPPC unit was inspected in Esbjerg before sailed to the platform and subsequently some equipment had to be replaced with smaller units transported to the rig by hand (10 kg overload in the helicopter).

Laboratory

The Mærsk container was localised on the rig deck close to the leg in port side. The laboratory was established and tested during the first night and the following day at the rig. The PPPC unit was used by the technician for the first time so the first test was performed with water only to avoid any contamination of the working area with any chemicals. After practising, cleaning and tightening of some leaks a test sample was prepared, and preparation of a second test sample was used to minimise preparation time. Both sample proved nicely well preserved Lower Miocene palynofloras. The acid-neutralising effect of PPPC and the surroundings of the PPPC were carefully tested for free HF and other acids during both the test preparations and the whole working periode; nothing was detected.

When the drilling was abandoned, the laboratory was packed in four hours into boxes, which were secured in the container for shipping back to Esbjerg.

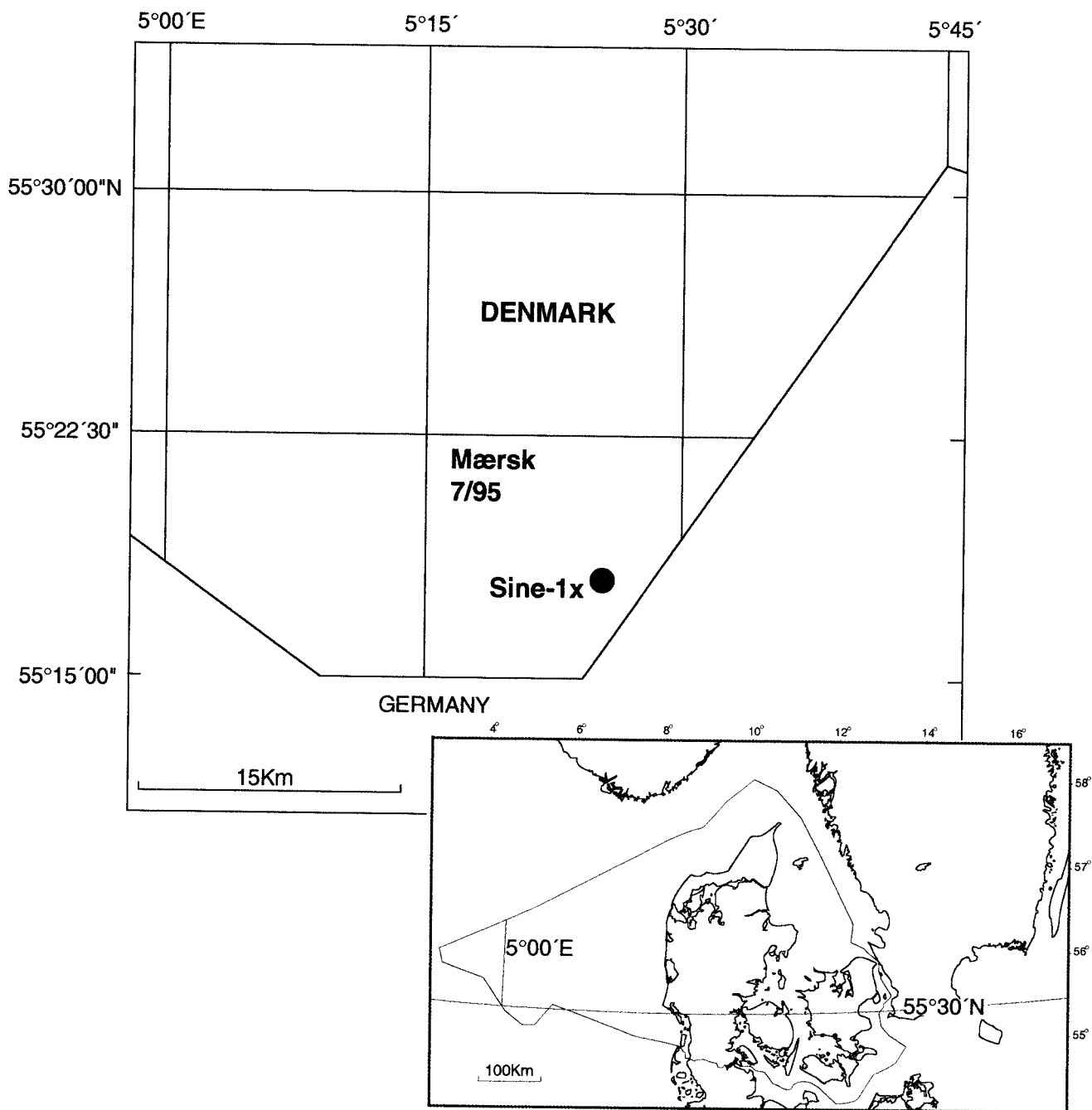


Figure 1: Position of the Sine-1x well in the Danish North Sea.

Analysed material

Two test samples and four samples of cuttings from the drilling were prepared and analysed.

Sample: Cavings of dark micaceous Tertiary mudstone provided by the well-site geologist

Size: 20 gram

Preparation time: 2:00 hours

Result: Abundant Lower Miocene dinoflagellate cyst assemblage mixed with some Middle Miocene species

Age: Latest Early Miocene, Burdigalian

Zonation: Lower dinocyst zone D16-17 equivalent to nannoplankton zones NN2-4

Sample: Dark micaceous mudstone plastered to drill head and sampled during change of the drill head

Sample size: 20 gram

Preparation time: 1:20 hours

Result: Abundant Lower Miocene dinoflagellate cyst assemblage

Age: Early Miocene, top Aquitanian to lowest Burdigalian

Zonation: Lower dinocyst zone D16-17 equivalent to nannoplankton zones NN2-3

Sample 9030 ft.: Chalk

Sample size: 20 gram

Preparation time: 1:40 hours

Result: Barren of *in situ* palynomorphs; contamination of Upper Cretaceous and Tertiary dinoflagellate cysts

Content: Abundant *Spiniferites*

Chatangiella tripartita

Cf. *Isabeladinium cooksonia*

Cf. *Systematophora sibyllum*

Cf. *Trichodinium castanea*

Cf. *Stiphosphaeridium* sp.

Cf. *Pseudoceratium anaphrissa*

Operculodinium centrocarpum

Wetzelliella sp.

Thalassiphora sp.

Spiniferites ramosus

Eatonicysta ursulae

Sample 9185 ft.: Dominantly red clay

Sample size: 40 - 60 gram

Preparation time: 1:35 hours

Result: Barren of *in situ* palynomorphs; contamination of (Upper Cretaceous and) especially Tertiary dinoflagellate cysts

Content: *Operculodinium centrocarpum*

Lingulodinium machaerophorum

Hystrichokolpoma rigaudiae

Hystrichosphaeridium choanophorum
Cyclopsiella elliptica
Spiniferites pseudofurcatus
Cordosphaeridium cantharellum
Reticulosphaera actinocoronata
Spiniferites ramosus
Etonicysta ursulae
Cordosphaeridium sp.
Spiniferites sp.
Cf. *Chatangiella* sp.
Tanyosphaeridium cf. *variecalamus*
Cerodinium cf. *speciosum*
Bisaccates *indet.*
Sporae *indet.*
Algae
Fungi

Sample 9210 ft.: Red clay and associated lithologies e.g crystalline basement clasts

Sample size: 40-60 gram

Preparation time: Approximately 1:45 hours

Result: Barren of *in situ* palynomorphs; contaminated by Tertiary dinoflagellate cysts

Content: *Bisaccates* *indet*

Abundant Tertiary dinoflagellate cysts

Apteodinium/Cribroperidinium sp.

Spiniferites sp.

Deflandrea sp.

Oligosphaeridium sp.

Sample 9215 ft.: Red clay and grey to white clay (kaolinite?) with clasts of disintegrating crystalline basement rocks:

Sample size: 50 - 100 gram,

Preparation time: 2:11

Result: Barren of *in situ* palynomorphs; contamination of Tertiary dinoflagellate cysts

Content: *Bisaccates* *indet*

Triporate pollen

Tertiary dinoflagellate cysts

Cf. *Tanyosphaeridium* sp.

Cf. *Pareodinia/Batioladinium* sp.

Biostratigraphical results

No direct biostratigraphical conclusions can be based on the results from the prepared and analysed samples (except the test samples) due to the absence of indigenous palynomorphs. Chalk is generally poor in palynomorphs and requires very large samples (kilograms) to concentrate just a limited assemblage of palynomorphs. The red clay, kaolinite and crumbling crystalline basement rocks drilled below the chalk reflect the worst depositional environment for preservation of palynomorphs. Severe oxidation of the exposed sediments degrades all organic matter in the sediments and only black, coaly grains remain.

The main result of this study is that the sub-chalk sediments were not traditional Jurassic sediments. So the time consuming setting of casing to the basis of the chalk was avoided and the drilling continued, but only to be abandoned shortly after.