A palynological study of the lowermost Nordland Shale Formation in Norwegian Well 15/9-A11 at 906.00 m

Responsive Programme
Internal Report CR/03/001
A palynological study of the lowermost Nordland Shale Formation in Norwegian Well 15/9-A11 at 906.00 m

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Key words
palynomorphs, biostratigraphy, palaeoecology, Pliocene.

Bibliographical reference
Foreword

This report is based on a palynological investigation of a single sample of conventional core from 906.00 m in Norwegian offshore well 15/9-A11. This horizon lies within the lowermost Nordland Shale Formation. This unit is the cap rock for the Utsira Formation. The sample is of suspected Miocene-Pliocene age and this investigation aims to determine the age and environment of deposition.

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Summary

The sample studied is interpreted as being of Late/latest Pliocene age based on its low diversity dinoflagellate cyst flora which is dominated by Brigantedinium spp. and includes low proportions of Selenopemphix quanta. Selenopemphix quanta is known to extend into the Pliocene and the overall dinoflagellate cyst flora does not resemble any known Early Pleistocene assemblages in the North Sea region. The abundance of Brigantedinium spp., the low diversity nature of this association and the common plant spores points to an inner neritic palaeoenvironment, close to an area of high fluvial output.
1 Introduction

A single sample of conventional core from 906.00 m in Norwegian offshore well 15/9-A11 was submitted for palynological analysis. This horizon is within the lowermost Nordland Shale Formation, and this is the cap rock for the Utsira Formation. The sample is of suspected Miocene-Pliocene age and this investigation aims to determine the age and environment of deposition. Previous studies (e.g. Eidvin et al., 1999; Piasecki et al., 2002) indicate that a Late Pliocene age is most likely. The lithology is dark green clay, with a crude fabric of laminae and no visible macrofossils. This small (c. 15 g.) sample was registered in the BGS collection as number MPA 51092, it was prepared using the conventional mineral acid digestion method.

2 Palynology

The sample produced a moderately abundant organic residue and palynoflora. Palynomorphs are relatively abundant and are well preserved. Some reworking was noted. The kerogen assemblage comprises common wood fragments with lesser proportions of other plant tissues and amorphous organic material. Resistant mineral grains are present; most of these are a distinctive light blue colour. Appendix 1 gives a listing of the palynomorph taxa recognised.

The palynoflora comprises both indigenous marine and terrestrial-derived forms. Dinoflagellate cysts are the most common component, however are not diverse (Appendix 1). The most common forms are Brigantedinium spp., indeterminate forms, Lejeunecesta spp., Selenopemphix nephroides and Spiniferites spp. A Miocene age is precluded by the absence of key Miocene marker dinoflagellate cyst such as Unipontidinium aquaeductum (see Powell, 1992) and the low diversity. The presence of Selenopemphix quanta suggests that the sample is no older than Late/latest Pliocene. Harland (1992, fig. 5.2) indicated that the range base of Selenopemphix quanta (as Protoperidinium conicum) is pre-Pleistocene, although there are few records of this species from the Pleistocene. Selenopemphix quanta is present throughout the Quaternary and may be common (Harland, 1992; Head, 1998, table 1, Riding et al., 1997; 2000). The overall dinoflagellate cyst association does not appear to be of Early Pleistocene (or Quaternary generally) in character (Cameron et al., 1984; Harland, 1988; 1992; Harland et al., 1991), therefore it is interpreted as being Late/latest Pliocene in age. For example Operculodinium spp. are absent. The low dinoflagellate cyst diversity is also consistent with the Late/latest Pliocene; this interval is typified by low dinoflagellate cyst abundances and diversities due to global cooling at this time (De Vernal and Mudie, 1992; Stover et al., 1996, p. 720). The horizon is probably very close to the Pliocene-Pleistocene transition.

Peridiniacean dinoflagellate cysts dominate the assemblage. This, particularly the abundance of Brigantedinium spp., and the low diversity, indicate a nearshore, inner neritic palaeoenvironment (Stover et al., 1996, p. 718). Abundant Brigantedinium spp. can indicate areas of upwelling areas, rich in nutrients (Bujak, 1984). This scenario is not envisaged for the northern North Sea and Head et al. (1989) reported that common/abundant Brigantedinium spp. are consistent with areas of high fluvial discharge such as an estuary. The abundance of congruentidiacean (‘protoperidiniacean’) forms such as Brigantedinium spp. is also typical of high latitude Miocene-Holocene associations. Eidvin et al. (1999) reported that the underlying Utsira Sand Formation is of latest Mid Miocene to earliest Late Pliocene on foraminiferal evidence. Furthermore, Piasecki et al. (2002) concluded that the Utsira Sand Formation of well 15/9-A23 is Early Pliocene in age. Thus both the studies of Eidvin et al. (1999) and Piasecki et al. (2002) are therefore consistent with the lowermost Nordland Shale Formation cap rock being of Late/latest Pliocene age.
The pollen/spore association is also of low diversity. Age diagnostic taxa are absent and the flora is dominated by undifferentiated bisaccate pollen, some of which may be reworked. Carboniferous and possibly Jurassic/Cretaceous reworking is also present (Appendix 1). The low diversity and the occurrence of reworking precludes a detailed palaeoecological assessment based on miospores. However, the common occurrence of spores such as *Laevigatosporites* spp., *Lycopodiumsporites* spp., *Polypodium* sp. and *Stereisporites* spp. suggests a wet, low lying, nearshore setting.

### 3 Conclusions/Summary

Sample MPA 51092 is interpreted as being of Late/latest Pliocene age based on its low diversity dinoflagellate cyst flora which is dominated by *Brigantedinium* spp. and includes low proportions of *Selenopemphix quanta*. *Selenopemphix quanta* is known to extend into the Pliocene and the overall dinoflagellate cyst flora does not resemble any known Early Pleistocene assemblages in the North Sea region. The abundance of *Brigantedinium* spp., the low diversity nature of this association and the common plant spores points to an inner neritic palaeoenvironment, close to an area of high fluvial output, such as an estuary.

### Appendix 1  Listing of palynomorph taxa recognised

This Appendix lists all palynomorphs recognised in this study, alphabetically in their constituent groups. The number of specimens per microscope slide is indicated in the right hand column. (R) = reworked.

**Dinoflagellate cysts:**

- *Achromosphaera* spp. 2
- *Barssidinium* sp. 1
- *Batiacasphaera* spp. 7
- *Brigantedinium* spp. 543
- chorate dinoflagellate cysts – indeterminate 32
- dinoflagellate cysts – indeterminate 29
- *Habibacysta* sp. 1 + ?1
- *Lejeunecysta* spp. 14
- *Lejeunecysta* sp. (dark and denticulate) 31
- ?cysts of *Polykrikos schwartzii* 4
- *Selenopemphix nephroides* 23
- *Selenopemphix quanta* 2
- *Selenopemphix* sp. 1
- *Spiniferites* spp. 51

**Miscellaneous microplankton:**
Acanthomorph acritarchs – indeterminate 33

Botryococcus braunii 1

foraminiferal test linings 52

Microhystridium spp. 39

Pollen:

bisaccate pollen – undifferentiated 391

Compositae pollen 1

Inaperturopollenites hiatus 2

?Perinopollenites elatoides (?R) 1

pollen grains – indeterminate 30

Spores:

Carboniferous spore – indeterminate (R) 1

Cicatricosisporites sp. (R) 1

Cyathidites spp. 29

Densosporites spp. (R) 4

Laevigatosporites spp. 7

Lycopodiumsporites spp. 11

Lycospora pusilla (R) 2

Polypodium sp. 1

Stereisporites spp. 22

References


