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# A palynological investigation of diamictons and tills from northeast England

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BRITISH GEOLOGICAL SURVEY

INTERNAL REPORT IR/07/021R

# A palynological investigation of diamictons and tills from northeast England

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# Foreword

This report comprises a study of the palynology of three samples of diamictons and tills from northeast England.

## Contents

<b>Foreword .....</b>	<b>1</b>
<b>Contents.....</b>	<b>1</b>
<b>Summary .....</b>	<b>1</b>
<b>1 Introduction .....</b>	<b>1</b>
<b>2 Sample Details .....</b>	<b>1</b>
<b>3 Palynology .....</b>	<b>1</b>
<b>4 Summary .....</b>	<b>2</b>
<b>5 References .....</b>	<b>3</b>

## Summary

The palynofloras of samples 3 and 1 are virtually entirely Late Carboniferous spores, indicating probable derivation from the Newcastle coalfield, to the north. No palynological expression of the Magnesian Limestone was present. This unit underlies the Quaternary succession at Warren House Gill and probably reflects the organic-lean nature of this unit. The palynology of the shelly 'Scandinavian Drift'/Warren House Till/Warren House Formation (sample 2) is profoundly different. It is a mixed assemblage with low numbers of presumably local Carboniferous spores. Other elements comprise low numbers of Mesozoic forms, significant proportions of Eocene dinoflagellate cysts, and a dominance of presumed Quaternary pollen/spores (Table 1). Some proportions of non-age diagnostic palynomorphs were also recovered. The Mesozoic, Eocene and Quaternary elements are interpreted as being derived from the North Sea Basin. Therefore the palynology is entirely consistent with the evidence from erratic clasts, which indicates a Scandinavian/North Sea provenance.

# 1 Introduction

The palynology of three samples of diamictons and tills from northeast England was studied in order to determine the provenance/derivation of these glaciogenic sediments. The study was undertaken in order to help better understand the glacial history of the area. The samples are from Warren House Gill and Whitburn Bay.

The principal purpose of this work was to help elucidate the provenance of the shelly ‘Scandinavian Drift’ (sample 2), and adjacent tills/diamictons. The ‘Scandinavian Drift’, Warren House Till or Warren House Formation (Trechman, 1915; Francis, 1972; Thomas, 1999 respectively) is well developed at Warren House Gill (NZ 436 426). It occurs locally, at the base of the Quaternary succession in this buried valley cut into Magnesian Limestone. The ‘Scandinavian Drift’, a shelly deposit, is overlain by loess, Devensian Till and outwash sand and gravel. It is a tectonised grey, sandy clay with rounded erratic clasts from Scandinavia and the North Sea Basin (Trechman, 1915; 1931; Francis, 1972). There has been debate as to the age of the ‘Scandinavian Drift’ and ages of MIS 6 and MIS 8 have been suggested (Lunn, 1995; Bridgland, 1999; Thomas, 1999).

## 2 Sample Details

The samples studied are listed in the table below, and further details follow.

No.	BGS Reg. No.	Coll. No.	Grid Ref.	Unit	Locality
1	MPA 55872	WH 06		Upper diamicton	Whitburn Bay
2	MPA 55873	WHG 09	NZ 436 426	‘Scandinavian Drift’	Warren House Gill
3	MPA 55874	WHG 10	NZ 436 426	Till	Warren House Gill

## 3 Palynology

In this section of the report, the palynofloras are fully described. Full listings of palynomorphs, including quantitative and semiquantitative data, are held on the respective BGS micropalaeontology/palynology data sheets, which have been archived. The samples were prepared using the sodium hexametaphosphate method of Riding and Kyffin-Hughes (2004; 2006) and Riding et al. (2006). The matrix and the erratic clasts were not separated. The three samples all proved productive, with abundant kerogen and palynomorph associations, and the results are summarised in Table 1.

### 3.1.1 SAMPLE 3 (WHG 10; MPA 55874)

This sample proved extremely productive, with abundant kerogen and palynomorphs; the most prominent elements were wood fragments, with lower proportions of plant tissue and well-preserved palynomorphs. The palynomorphs are virtually entirely of Carboniferous age. They are dominated by *Densosporites* and *Lycospora pusilla*. Lower numbers of *Calamospora* sp., *Cirratiradites saturni*, *Endosporites globiformis*, *Florinites* spp., *Radiizonates* spp., and *Tripartites vetustus* were also encountered. The occurrence of *Endosporites globiformis* is

indicative of the Namurian and Westphalian (Late Carboniferous) (Smith and Butterworth, 1967). Extremely small numbers of pollen of Quaternary aspect, e.g. *Pinus*, are also present (Table 1). Because of the overwhelming dominance of Carboniferous spores, the provenance of this till is interpreted as being local, i.e. being derived from British ice.

### 3.1.2 SAMPLE 2 (WHG 09; MPA 55873)

Sample 2 proved profoundly different inorganic content to samples 3 and 1. Wood fragments are common, however the residue is dominated by other plant tissue, and a mixed assemblage of palynomorphs that are of Carboniferous to Quaternary age (Table 1).

Carboniferous spores, largely *Densosporites* and *Lycospora pusilla*, are relatively rare, comprising 2.3% of the assemblage. These may have been sourced locally. Jurassic and Lower Cretaceous grains were observed in extremely low proportions (Table 1). A single specimen of the Late Jurassic (Oxfordian-early Kimmeridgian) dinoflagellate cyst *Gonyaulacysta jurassica* subsp. *jurassica* was identified. Additionally, the characteristic Early Cretaceous forms *Cicatricosisporites* spp. (spores) and *Cribroperidinium* (dinoflagellate cyst) were observed in low numbers (0.3%). Given the local geology, it is extremely unlikely that these were sourced from onshore UK. The most likely source is from the east, in the North Sea Basin. Significant numbers of Eocene dinoflagellate cysts are present. These include *Areosphaeridium diktyoplokum*, *Deflandrea oebisfeldensis*, *Eatonicysta ursulae*, undifferentiated chorate (i.e. process-bearing) forms, and *Homotryblum* spp. This association is indicative of the Eocene. *Areosphaeridium diktyoplokum* and *Eatonicysta ursulae* range from the Ypresian to Priabonian and the Ypresian to Lutetian respectively (Powell, 1992). The range of *Deflandrea oebisfeldensis* is Late Palaeocene to Early Eocene (Powell, 1992). This significant input of Eocene material is interpreted as deriving from the North Sea Basin, to the east. The Eocene of southern England is known to contain some Mesozoic reworking hence it is possible that the Late Jurassic and Early Cretaceous grains were derived secondarily, from the Eocene material. Large amounts (73.4%) of pollen of Quaternary aspect are present. These include *Alnus*, *Corylus*, Filicales, *Pinus*, *Sphagnum*-type, and *Tilia*. It is possible that some of these forms may be older, but it is not possible to be certain. A Quaternary age seems most likely and the most likely source are coastal sediments at the western margin of the North Sea Basin. A number (12.1%) of long-ranging palynomorphs were recorded. These include alga such as *Pediastrum*, and pre-Quaternary bisaccate pollen grains.

### 3.1.3 SAMPLE 1 (WH 05; MPA 55872)

Sample 1 yielded abundant kerogen and palynomorphs. Wood fragments and well-preserved palynomorphs are present, with lower proportions of non-woody plant tissue. The palynomorphs are entirely of Carboniferous age, and are dominated by the long-ranging forms *Densosporites* and *Lycospora pusilla*. Lower numbers of *?Endosporites globiformis*, *Florinites* spp., *Radiizonates* spp., *Tripartites trilinguis*, and *Tripartites vetustus* were also encountered. The occurrence of *Radiizonates* spp., is indicative of the Westphalian (Late Carboniferous) (Smith and Butterworth, 1967). However the presence of species of *Tripartites* means that some Namurian input is possible. Because of the absence of any other elements except Carboniferous spores, the provenance of this till is interpreted as being local, i.e. being derived from British ice.

## 4 Summary

The palynofloras of samples 3 and 1 are virtually entirely Late Carboniferous spores, indicating probable derivation from the Newcastle coalfield, to the north. No palynological expression of the Magnesian Limestone was present. This unit underlies the Quaternary succession at Warren

House Gill and probably reflects the organic-lean nature of this unit. The palynology of the shelly 'Scandinavian Drift'/Warren House Till/Warren House Formation (sample 2) is profoundly different. It is a mixed assemblage with low numbers of presumably local Carboniferous spores. Other elements comprise low numbers of Mesozoic forms, significant proportions of Eocene dinoflagellate cysts, and a dominance of presumed Quaternary pollen/spores (Table 1). Some proportions of non-age diagnostic palynomorphs were also recovered. The Mesozoic, Eocene and Quaternary elements are interpreted as being derived from the North Sea Basin. Therefore the palynology is entirely consistent with the evidence from erratic clasts, which indicates a Scandinavian/North Sea provenance.

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Sample	Grains	Carboniferous	Jurassic	L. Cretaceous	Eocene	Quaternary	Non age-
No.	per slide	spores	dino. cysts	palynomorphs	dino. cysts	miospores	diagnostic
1	N/A	100%	...	...	...	...	...
2	1423	33 (2.3%)	1 (0.1%)	4 (0.3%)	168 (11.8%)	1045 (73.4%)	172 (12.1%)
3	N/A	ca. 99%	...	...	...	ca. 1%	...

Table 1. The numbers and percentages (in parentheses) of Carboniferous, Jurassic, Lower Cretaceous, Palaeogene, Quaternary, and non-age diagnostic palynomorphs in the samples studied. Three dots (...) indicates the absence of the respective age/group of palynomorphs.