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A palynological investigation of two samples of the Thrussington Till from the Leicester district

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A palynological investigation of two samples of the Thrussington Till from the Leicester district

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Foreword

This report comprises a study of the palynology of two samples of the Thrussington Till from the Leicester district.

Contents

Summary

Sample 1 proved extremely organically-productive; the palynoflora comprises Carboniferous, Triassic, Jurassic and Quaternary forms. Upper Carboniferous (Westphalian) miosopores are the most prominent element (40.9%), thereby indicating reworking of significant levels of Coal Measures into the Thrussington Till south of Leicester city centre. The most likely source of these Carboniferous spores is the Pennines to the north. Late Triassic (Rhaetian) palynomorphs are also present in moderate proportions (5.9%). The most likely lithostratigraphical units which provided this Rhaetian input are the Westbury and/or Lilstock formations from the local area. Jurassic palynomorphs are relatively prominent (27.1%). These are dominated by miospores that comprise 26.4% of the entire flora. The presence of key markers indicates input from Toarcian and Mid-Late Jurassic strata. It is possible that many of these miospores were derived from the several paralic deposits of the Middle Jurassic succession of the East Midlands Shelf to the north-east. Jurassic dinoflagellate cysts are, by contrast, rare (0.7%) and indicate input from the late Callovian to early Oxfordian Stewartby and/or Weymouth members of the Oxford Clay Formation from the outcrop north-east of Leicester. Low levels (1.3%) of Quaternary pollen grains of aspect were observed and these are assumed to have been derived locally. Forms that are stratigraphically non-diagnostic are present in significant proportions (24.8%), and no evidence of input from the Lower Palaeozoic, Devonian, Permian or Cretaceous-Neogene was observed.

Sample 2 also yielded an abundant and well-preserved palynoflora that is entirely comprised of Westphalian (Upper Carboniferous) miospores. This means that large levels of Coal Measures were incorporated into the Thrussington Till at Braunstone. It is highly unusual to encounter a till which is characterised by a non-heterogenous assemblage. The source of these spores is most likely to be the Pennines. The absence of Late Triassic forms in this sample is interesting because other Thrussington Till samples have yielded Rhaetian palynomorphs. The Westphalian miospores represent the far-travelled component; whereas the Rhaetian palynomorphs are locally-derived. It is possible, for example, that the local component diluted the far-travelled component dependent on the availability of Rhaetian strata in the path of the glacier. A detailed study of a complete section of the Thrussington Till would be required in order to fully assess the organic heterogeneity of this unit.

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1 Introduction

The palynology of two samples of the Thrussington Till from the Leicester area were studied. This project is aimed at determining the provenance and derivation of the Thrussington Till from its allochthonous palynomorphs. The study was undertaken in order to contribute to the geological mapping of this region, and to help better understand the glacial history.

The Thrussington Till is present throughout the Leicester area at the base of the glaciogenic succession. It is typically a diamicton with a matrix of brown/red-brown silty or sandy clay. Erratic clasts are normally dominated by Carboniferous and Triassic lithologies. These clasts are assumed to have been derived from the Pennines and locally respectively. A sample of the Thrussington Till from a temporary excavation east of Canal Street, Wigston (SP 5902 9811) yielded a reworked palynoflora dominated by Rhaetian grains with minor levels of Carboniferous and Quaternary input (Riding, 2004).

2 Sample Details

The two samples of the Thrussington Till studied are listed below. The columns are the (informal) sample number, the BGS micropalaeontological registration number (prefixed MPA), the collectors number (prefixed JNC), the grid reference and details of the location respectively. Both samples were collected by J. N. Carney.

1	MPA 53830	JNC 905	SK 5932 0285	Borehole SK50SE/763 at 11.3 m.
2	MPA 53831	JNC 906	SK 5478 0129	Temporary excavation s. of Watergate Lane, Braunstone

Sample 1 is from a borehole sited on the campus of Leicester University and is a till with a red-brown matrix with clasts of ?Carboniferous Limestone, coal and Triassic sediments. Sample 2 is of a Thrussington Till facies that is known to include local inclusions of the Oadby Till. However, no Oadby Till fragments are present in the sample collected.

3 Palynology

In this section, the palynofloras are described in two sections. Full listings of palynomorphs, including semiquantitative data, are held on the respective BGS micropalaeontology/palynology data sheets, which have been archived. The material was all prepared using the sodium hexametaphosphate method of Riding and Kyffin-Hughes (2004). Table 1 illustrates the numbers and percentages of the various age-based palynomorph groups in sample 1

3.1 SAMPLE 1 (JNC 905)

Sample 1 yielded an extremely abundant, well-preserved palynoflora that comprises material of Carboniferous, Triassic, Jurassic and Quaternary age (Table 1, see below). Wood and plant tissue were also prominent.

Carboniferous miospores are the most prominent element (40.9%; Table 1); *Densosporites* spp. and *Lycospora pusilla* are the most common forms. Also present are *Calamospora* spp., *Cirratriradites saturni*, *Endosporites globiformis*, *Florinites* spp., *Radiizonates* spp., *Raistrickia* spp., *Reinschospora speciosa*, *Reticulatisporites* spp. and *Vestispora* spp. This association

indicates the reworking of Upper Carboniferous (Westphalian) strata. For example, *Cirratriradites saturni, Endosporites globiformis* and *Vestispora* spp. are all confined to the Westphalian (Smith and Butterworth, 1967; Clayton and Butterworth, 1984). This means that significant levels of Coal Measures material was incorporated into the Thrussington Till at this locality. The nearest Upper Carboniferous outcrops to the Leicester area are to the north and the north-west; these are the Nottinghamshire/Derbyshire and south Derbyshire coalfields respectively. In view of the fact that the Jurassic material was probably sourced from the north-east (see below), it is unlikely that the Westphalian spores were sourced from the Swadlincote area. The Pennines as the source of the Carboniferous spores is most likely, however, it is also possible that the Westphalian input is from further north, for example from the Northumberland and Durham coalfield.

Significant numbers of palynomorphs (5.9%) indicate derivation from the Late Triassic (Rhaetian) (Table 1). The miospores *Kraeuselisporites reissingeri, Ovalipollis ovalis, Ricciisporites tuberculatus* and undifferentiated taeniate pollen, and the dinoflagellate cyst *Rhaetogonyaulax rhaetica* were observed. These species are confined to the Rhaetian Stage according to Morbey and Dunay (1978) and Powell (1992) respectively. The potential lithostratigraphical units which provided this Rhaetian input are the Blue Anchor, Westbury and Lilstock formations. The Blue Anchor Formation tends to be organic-poor, hence the source of the Rhaetian palynomorphs is deemed to be probably from the Westbury and/or Lilstock formations. Furthermore, *Rhaetogonyaulax rhaetica* tends to be confined to the Westbury and Lilstock formations (Warrington et al., 1995; Warrington, 1997). This Late Triassic input is assumed to be local. It is similar to the Rhaetian assemblage from the Thrussington Till from a temporary excavation east of Canal Street, Wigston and also from the Lias-Rich Till of Seagrave Road, near Thrussington (Riding, 2004).

Spores and pollen of Jurassic aspect proved common to abundant, comprising 26.4% of the flora (Table 1). The taxa identified comprise *Callialasporites* spp., *Chasmatosporites* spp., *Classopollis classoides, Classopollis meyeriana, Perinopollenites elatoides* and *Retitriletes austroclavatidites*. The presence of *Chasmatosporites* spp. and *Callialasporites* spp. indicates input from the Toarcian and Mid-Late Jurassic strata (Riding et al., 1991). It is possible that many of the Jurassic miospores are derived from the several freshwater/terrestrial deposits of the Middle Jurassic succession of the East Midlands Shelf to the north-east. Jurassic dinoflagellate cysts are rare (0.7%), and comprise *Gonyaulacysta centriconnata, Gonyaulacysta jurassica* subsp. *adecta* var. *adecta, Rhynchodiniopsis cladophora* and *Tubotuberella dangeardii.* This association is characteristic of the late Callovian to early Oxfordian interval. *Gonyaulacysta centriconnata* is confined to this interval (Riding and Thomas, 1992). This is indicative of the incorporation of low levels of the Stewartby and/or Weymouth members of the Oxford Clay Formation. It seems likely that this was derived locally, from the Oxford Clay Formation outcrop to the north-east of Leicester.

Low numbers (1.3%) of pollen grains of Quaternary aspect were observed (Table 1). These are dominated by *Pinus*, and are assumed to be locally-derived.

Forms that are stratigraphically non-diagnostic such as *Botryococcus* and *Tasmanites* are present in significant proportions (24.8%; Table 1). No evidence of input from the Lower Palaeozoic, Devonian, Permian or Cretaceous-Neogene was observed.

	Number per slide	Percentage (%)
Carboniferous spores	548	40.9
Triassic miospores	46	3.4
Triassic dinoflagellate cysts	33	2.5
Jurassic miospores	354	26.4
Jurassic dinoflagellate cysts	9	0.7

Quaternary miospores	17	1.3
Non age-diagnostic palynomorphs	333	24.8

Table 1 - The numbers per microscope slide and percentages of Carboniferous spores, Triassic miospores, Triassic dinoflagellate cysts, Jurassic miospores, Jurassic dinoflagellate cysts, Quaternary miospores and non age-diagnostic palynomorphs in sample 1 of this study.

3.2 SAMPLE 2 (JNC 906)

Sample 2 also yielded an abundant organic residue and palynoflora. Wood and plant tissues are common and the preservation level is good. The palynoflora is entirely comprised of Carboniferous miospores including *Calamospora* spp., *Cirratriradites saturni, Densosporites* spp., *Endosporites globiformis, Endosporites zonalis*, *Florinites* spp., *Laevigatosporites* spp., *Lycospora pusilla, Radiizonates* spp., *Raistrickia* spp., *Reticulatisporites* spp. and *Vestispora tortuosa.* This association indicates the reworking of Upper Carboniferous (Westphalian) strata only. No characteristically non-Carboniferous palynomorphs were observed. For example, *Cirratriradites saturni, Endosporites globiformis, Endosporites zonalis* and *Vestispora tortuosa* are all confined to the Westphalian (Smith and Butterworth, 1967; Clayton and Butterworth, 1984). *Vestispora tortuosa* is restricted to the mid Westphalian A to the mid Westphalian C. This means that large levels of Coal Measures were incorporated into the Thrussington Till at this locality. It is unusual to encounter a till which is characterised by a non-mixed assemblage. It is possible that other lithotypes were incorporated, but are organic-poor. An example of such an organic-lean unit would be Carboniferous Limestone.

The total absence of Late Triassic taxa in this sample is intriguing. Allochthonous palynomorphs of this age are present, albeit in relatively low proportions, in sample 1 (section 3.1). Moreover, a sample of Thrussington Till from Wigston proved extremely rich in Rhaetian grains (Riding, 2004). This means that the Thrussington Till clearly exhibits considerable organic heterogeneity. Multiple samples from an expanded reference section would be required to ascertain the relative proportions of Westphalian and Rhaetian palynomorphs throughout this unit. This approach would determine which organic signature is most characteristic, and/or if there are marked vertical differences in the palynomorph content within this unit. It would appear that abundances in both Westphalian miospores and Rhaetian palynomorphs is characteristic of the Thrussington Till. The Westphalian miospores are the far-travelled component; by contrast, the Rhaetian palynomorphs are assumed to have been locally-derived. The differences in the relative proportions of these two components could be due to local factors, such as the limited availability of Rhaetian strata. The glacier producing this deposit is assumed to have had consistently relatively high levels of entrained reworked Westphalian debris. This could have been diluted by local Late Triassic material, depending on the presence or absence of these beds locally. For example it is possible that the glacier eroded all available local Late Triassic sediments during the deposition of the Thrussington Till, meaning that younger levels of this till would be devoid of Triassic elements and thus are dominated by Westphalian grains. Again, this contention could be proved with a detailed study of a complete section of the Thrussington Till.

The nearest Westphalian outcrops to this area are the Nottinghamshire/Derbyshire and south Derbyshire coalfields to the north and the north-west respectively. Because the Jurassic material of sample 1 was probably sourced from the north-east (see section 3.1), it is unlikely that these Westphalian spores were sourced from the south Derbyshire coalfield. The source of these spores is most likely to be the Pennines.

4 Summary

Sample 1 proved extremely organically-productive; the palynoflora comprises Carboniferous, Triassic, Jurassic and Quaternary forms. Upper Carboniferous (Westphalian) miosopores are the most prominent element (40.9%), thereby indicating reworking of significant levels of Coal Measures into the Thrussington Till south of Leicester city centre. The most likely source of these Carboniferous spores is the Pennines to the north. Late Triassic (Rhaetian) palynomorphs are also present in moderate proportions (5.9%). The most likely lithostratigraphical units which provided this Rhaetian input are the Westbury and/or Lilstock formations from the local area. Jurassic palynomorphs are relatively prominent (27.1%). These are dominated by miospores that comprise 26.4% of the entire flora. The presence of key markers indicates input from Toarcian and Mid-Late Jurassic strata. It is possible that many of these miospores were derived from the several paralic deposits of the Middle Jurassic succession of the East Midlands Shelf to the north-east. Jurassic dinoflagellate cysts are, by contrast, rare (0.7%) and indicate input from the late Callovian to early Oxfordian Stewartby and/or Weymouth members of the Oxford Clay Formation from the outcrop north-east of Leicester. Low levels (1.3%) of Quaternary pollen grains of aspect were observed and these are assumed to have been derived locally. Forms that are stratigraphically non-diagnostic are present in significant proportions (24.8%), and no evidence of input from the Lower Palaeozoic, Devonian, Permian or Cretaceous-Neogene was observed.

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5 References

CLAYTON, G. and BUTTERWORTH, M. A. 1984. Carboniferous range charts. *In: Pollen and spore biostratigraphy of the Phanerozoic in north-west Europe*. Proceedings volume of a British Micropalaeontological Society Palynology Group meting held at the University of Cambridge, 17th-19th December 1984, pp. 2-10.

MORBEY, S. J. and DUNAY, R. E. 1978. Early Jurassic to Late Triassic dinoflagellate cysts and miospores. *In:* THUSU B., (ed.). *Distribution of biostratigraphically diagnostic dinoflagellate cysts and miospores from the northwest European continental shelf and adjacent areas*. Continental Shelf Institute Publication, **100,** 47-59.

POWELL, A. J. 1992. Dinoflagellate cysts of the Triassic System. *In*: Powell, A. J. (ed.). *A stratigraphic index of dinoflagellate cysts*. Chapman and Hall, London, 1-6.

RIDING, J. B. 2004. A palynological investigation of two till samples from Leicestershire. *British Geological Survey Internal Report*, No. **IR/04/173**, 9 p.

RIDING, J. B. and KYFFIN-HUGHES, J. E. 2004. A review of the laboratory preparation of palynomorphs with a description of an effective non-acid technique. *Revista Brasileira de Paleontologia*, No. **7(1)**, 13-44.

RIDING, J. B. and THOMAS, J. E. 1992. Dinoflagellate cysts of the Jurassic System. *In:* Powell, A. J. (ed.). *A stratigraphic index of dinoflagellate cysts.* British Micropalaeontological Society Publications Series. Chapman and Hall, London, 7-97.

RIDING, J. B., WALTON, W. and SHAW, D. 1991. Toarcian to Bathonian (Jurassic) palynology of the Inner Hebrides, northwest Scotland. *Palynology,* **15,** 115-179.

SMITH, A. H. V., and BUTTERWORTH, M. A. 1967. Miospores in the coal seams of the Carboniferous of Great Britain. *Special Papers in Palaeontology*, No. **1**, 324 p.

WARRINGTON, G. 1997. The Lyme Regis borehole, Dorset – palynology of the Mercia Mudstone, Penarth and Lias groups (Upper Triassic – Lower Jurassic). *Proceedings of the Ussher Society*, **9**, 153-157.

WARRINGTON, G., IVIMEY-COOK, H. C., EDWARDS, R. A. and WHITTAKER, A. 1995. The Late Triassic – Early Jurassic succession at Selworthy, west Someset, England. *Proceedings of the Ussher Society*, **8**, 426-432.