Drigg Pollen Analysis

Introduction

In October 2000, Oxford Archaeology North (OA North) undertook an evaluation of a Bronze Age hearth or burnt mound at Drigg, West Cumbria (SD 0450 9860). Four 0.5m monoliths were taken of organic layers at two locations in the vicinity of the burnt mound. An initial assessment of four samples in 1999 and 2000 revealed that pollen was very abundant and well preserved. Four monolith samples were re-examined in 2010 and a total of 8 sub-samples was taken from three of the monoliths to assess the potential for pollen analysis. All pollen samples taken proved productive and yielded well preserved pollen comparable in quality to that of the original work in 2000. The upper section of one of the monolith samples (adjacent to the mound) assessed in 2010 showed a change from mixed alder/birch woodland to willow dominated landscapes. Cherry and Pennington (1965) originally reported a similar change and immediately overlying it they found evidence for extensive forest clearance. Detailed pollen analytical work has been undertaken on the peats above, contemporary with and below the burnt mound in an attempt to characterise the vegetation and possible land use at this site and to document the palaeoenvironmental history of the site.

Lithology

The original section from which the monoliths were sampled is shown on Figs. X and Y. The lithostratigraphic sequence shows sands and stones overlain by an organic layer within which a "burnt stone layer" (interpreted as a hearth) has been deposited. The "burnt stone layer" is overlain by bands of variably organic / sandy layers. Two samples, collected from the site in 1999, have been sub-sampled for pollen analysis. The first sample, referred to as the Drigg 1 is from the interval above the burnt stones horizon only. The second sample, a monolith core, Drigg 2 was located to the side of the burnt stones and extends into the organic sediments below and above the burnt stones horizon. The "burnt stones horizon" is interpreted as being present at 0.19m in both sections.

The lithology of the first section (Drigg1) comprises herbaceous, woody peat with sand throughout the interval analysed. The organic section seen in Drigg 2 is underlain by sands and stones, possibly correlative with beach sands described from the exposed cliff section sampled by Pennington (in Cherry and Pennington, 1965) and then interpreted to represent emerging beach deposits following relative sea-level fall. The organic section of the exposure was interpreted as an accumulation of organic material on a sandy forest floor. Above the organic layer, Pennington tentatively interpreted intercalated layers of sand and peat as representing the encroachment of blown sand and replacement of the forest by dunes (Pennington in Cherry and Pennington, 1965).

AMS Dating

Several radiocarbon dates were processed from the exposed section during the previous assessment phase (Marshall, 2009) bracketing the age of the burnt mound by dates from peats above and below the mound as well as dates from within the mound. English Heritage (Marshall, 2011) have used the dates from Marshall (2009) to provide dates by correlation for the pollen diagram representing sediments from Drigg 2, taken through the exposed Burnt Mound section. The dates provided are based on the assumptions that:

1) The burnt stone layer in Drigg Core 2 represents the same event/horizon (ie hearth/burnt mound) as the burnt stone layer in the main section (see Fig. X).

2) Peat accumulation at the site prior to and following the use of the hearth/burnt mound was fairly uniform, ie the date of the peat under the hearth/burnt mound in the main section is the same date as that under the "stone layer" in Drigg 2.

A single date is available (through correlation with the exposed section) for the lower part of the peat section sampled in Drigg 1 and is taken from immediately above the stone layer in the main section (Layer 14) ie the base of the section seen in pollen diagram 1. This means that the entire section seen in pollen diagram 1 must be younger than 2310-2140 cal BC (95%) (GU-5886) (Marshall 2009, 2011).

The dates provided suggest that immediately below the burnt stone layer at 19-20cm on the pollen diagram for Drigg 2 (Pollen diagram 2), a date of 2485-2345 cal BC (95%) (GU-5890) may be extrapolated by equivalence from Layer 16 in the main exposure. This equates with the top of PAZ (pollen assemblage zone) 2. The burnt stone layer at 19cm is assigned a date of 2435-2270 cal BC (92%) (GU-5885), equivalent to Layer 15 in the main section. The interval 18-19cm is assigned an age of 2310-2140 cal BC (95%), (GU-5886), extrapolated by equivalence with Layer 14 in the main section.

The overall dating suggests that an estimate for the initiation of peat deposition at the site is 3810-3650 cal BC (75%) (GU-5888), therefore peat was being deposited at the site during the Late Mesolithic. The Burnt Mound was out of use when it was sealed by peat which has been dated to 2310-2130 cal BC (95%) (GU-5886), within the early Bronze Age.

Methods of processing for pollen

Volumetric samples (1cc) were taken from thirty-five samples and two tablets containing a known number of *Lycopodium* spores were added so that pollen concentrations could be calculated (Stockmarr 1971). The samples were prepared using a standard chemical procedure (method B of Berglund & Ralska-Jasiewiczowa 1986), using HCl, NaOH, sieving, HF, and Erdtman's acetolysis, to remove carbonates, humic acids, particles >170 microns, silicates, and cellulose, respectively. The samples were then stained with safranin, dehydrated in tertiary butyl alcohol, and the residues mounted in 2000cs silicone oil. Slides were examined at a magnification of 400x by counting pollen along equally-spaced traverses until a total 500 total land pollen grains was counted. Pollen identification was made following the keys of Moore *et al* (1991), Faegri & Iversen (1989), and a small modern reference collection. Andersen (1979) was followed for the identification of cereal grains. Plant nomenclature follows Stace (1997). Charcoal particles greater than 5 microns were recorded (Peglar, 1993). Fungal spore identification (where present) and interpretation followed Blackford, J.J. *et al*. (in press).

Results

Calculations and presentations of the results

Analysis and storage of the data was achieved using the TILIA and TILIA-GRAPH software package (Grimm 1990), to categorise data and aid its interpretation. Pollen count sheets and the residues of prepared samples are stored at Oxford Archaeology North.

Presentation of results

Pollen data has been presented as a percentage diagram using the computer programs TILIA and TILIA-GRAPH (Grimm 1990). The percentage values are based on a pollen sum of all land pollen but excludes fern spores, aquatic taxa, fungal spores, *Copoepoda* and microscopic charcoal. A minimum count of 500 total land pollen grains was achieved for each level counted. There are very few grains that are indeterminate (e.g. crumpled or broken), apart from the uppermost samples taken from a sandy lithology from Drigg 2, due to the otherwise excellent preservation of the pollen grains and consequently, there is no curve for "indeterminates" shown on the pollen diagrams. All palynomorphs excluded from the pollen sum are expressed as a percentage of the pollen sum plus the group sum in which they belong. Microcharcoal values are expressed as a percentage of the pollen sum plus the charcoal counts. Fungal spore values are expressed as a percentage of the pollen sum plus the fungal counts. Summary percentage diagrams of trees and shrubs, crops, herbs, ferns and microscopic charcoal based on the same percentage values outlined above are also provided. In addition, pollen concentration diagrams have been prepared for both sections for selected taxa.

Description of pollen diagrams

Drigg 1 : Pollen diagram 1, 2 (percentage and summary), 3 (concentration)

Ten samples were analysed for pollen at 2cm intervals. Very little variation is seen through the section analysed and no zonal sub-divisions are suggested. The interval is probably equivalent to PAZ 4 in Drigg 2 and has been dated to the early Bronze Age (see AMS dates above). The assemblages describe alder carr woodland, mixed deciduous woodland with oak, birch, a little elm, and rare lime and ash as well as a shrub environment dominated by hazel and honeysuckle but also with lesser amounts of holly, ivy, elder and

members of the rose family, possibly including blackberry. The alder was probably growing in nearby damp areas with the deciduous woodland reflecting the regional vegetation. The diverse shrub assemblage probably comprised plants of the hedgerow. Small quantities of heather are also present as well as consistent but low values for *Pinus* (Pine). Heather and pine may have been growing locally on drier soils. Of significance is the relative abundance of willow, possibly suggestive of proximity to a damp environment or rising water table levels. Grasses and sedges are consistently present but do not attain a peak value in the section analysed. Herbs associated with waste ground and/or damp meadows are common and include representatives of the Asteraceae and Ranunculaceae families (daisy and buttercup families), as well as *Silene*-type and *Stellaria*-type (pinks), *Taraxacum*-type (dandelions), *Filipendula* (meadowsweet) and *Plantago lanceolata* (ribwort plantain). The presence of low counts for Cereal-type pollen may be referable to *Glyceria* (Sweet-grass) grains, as the environment was sufficiently damp to promote growth of this wetland grass. Microcharcoal is consistently present in low numbers throughout the zone. Fern spores are commonly present, again indicative of waste ground. Bog moss spores are present in low numbers throughout the section and non-pollen palynomorphs including *Mougeotia* spp. and *Copepoda* spp. indicate the temporary presence of shallow, open water.

Drigg 2: Pollen diagram 4, 5 (percentage and summary), 6 (concentration)
Thirty three of the thirty five sub-samples processed were analysed for pollen. The top two sub-samples at depths 0.02m and 0.04m from sand rich lithologies contained insufficient pollen.
PAZ-1 0.5-0.24m This woody, organic "peat" was sampled every 2cm. The summary diagram shows tree and shrub taxa dominate the assemblage. *Alnus* (Alder) is the most commonly occurring tree type, suggestive of local alder carr development and damp conditions. Damp woodlands favour the growth of mosses and *Sphagnum* spores have been found consistently throughout this section. The temporary presence of open water is indicated by the reasonably consistent, although low, counts of spermatophores of *Copepoda* (crustaceans common in freshwater habitats). The other trees and shrubs comprise mixed deciduous assemblages with roughly equal amounts of *Quercus* (Oak), *Corylus* (Hazel), *Betula* (Birch), and lesser amounts of woodland and shrub taxa including *Salix* (Willow), *Ulmus* (Elm), *Pinus* (Pine) as well as *Lonicera* (Honeysuckle) and *Ilex* (Holly). The tree and shrub taxa represent up to 90% of the overall pollen assemblage, the remaining 10% comprising herb and spore taxa. Of that 10%, Poaceae (Grasses) and Cyperaceae (Sedges) are most commonly recorded, followed by fern spores and low counts for *Pteridium* (Bracken). The overall assemblage suggests damp, alder woodland with possible open wet areas supporting sedges and mosses along with drier and diverse mixed woodland supporting a variety of tree and shrub vegetation. Rare occurrences of Cereal-type pollen may possibly be referred to *Glyceria* (Sweet-grass) grains, as the environment is wet enough to promote growth of this wetland grass. Microcharcoal is consistently present in low numbers throughout the zone.

PAZ-2 0.24m – 0.20m This interval is immediately below the "burnt stones layer" and comprises dark organic material with woody fragments and was also sub-sampled every 2cm for pollen. It is characterised by a relative decline in alder pollen and significant increase in birch pollen. Cereal-type pollen is present in the three pollen sub-samples in this zone.

PAZ-3 0.18m This PAZ is immediately above the "burnt stones layer"and comprises dark organic material with plant detritus and sand. The pollen sub-sample at 0.18m is placed in a pollen assemblage zone because of the dramatic decline in birch, the striking increase in microscopic charcoal and rises in both *Pteridium* (Bracken) spores and *Plantago lanceolata* (Ribwort Plantain). Pollen concentration values show this zone clearly (Pollen diagram 6).

PAZ-4 0.09-0.18m PAZ 4 was sub-sampled every 2cm and is distinguished by rising values and peak occurrences for *Salix* (Willow) and Cyperaceae (Sedges). Fern spores also peak during this interval. The alder and birch curves decline relative to PAZ-3 before recovering slightly, but do not attain proportions seen in PAZ-1 and PAZ-2.

PAZ-5 0.09-0.06cm Sub-samples were taken at 2cm intervals. This PAZ is characterised by an increase in bracken spores and increasing values for Poaceae (Grasses). Birch tree pollen is again seen to decline as do values for willow although pollen of other tree types remains at a consistent, relatively low level.

Discussion

Prior to the development of the burnt mound stone layer or hearth, the pollen data (PAZ 1) suggest damp, alder woodland with possible open wet areas supporting sedges and mosses. In addition, drier and diverse mixed woodland supporting a variety of tree and shrub vegetation is also recorded. Dating of this lower peat suggests a possible Mesolithic age for PAZ 1 (see dating section above and Marshall (2009)). A subsequent shift to relatively drier local conditions (PAZ 2) indicated by a significant increase in birch pollen, drop in alder and additionally by a decrease to near absence of both *Copepoda* spermatophores and *Sphagnum* moss spores, may be linked to a change in local coastal drainage conditions and consequent lowering of the water table. The possibility of re-growth of birch following possible clearance cannot be ruled out – this was a feature of Landnam-type early to mid Bronze Age woodland clearance, documented from the mires around Morcambe Bay (Wimble *et al*. 2000)). The available dating suggests that the upper part of PAZ 2 may date to the early Bronze Age (see dating section above and Marshall (2009)).

Indications for greater anthropogenic influence on the landscape are interpreted from PAZ 3. There is a dramatic decline in birch, a striking increase in microscopic charcoal and rises in both *Pteridium* (Bracken) spores and *Plantago lanceolata* (Ribwort Plantain) pollen grains. These data suggest possible clearance of birch woodland for grazing or fuel. The increase in microscopic charcoal indicates increased incidence of fire, which is unsurprising in an archaeological feature interpreted as a hearth or burnt mound.

The assemblages seen in PAZ 4 and in the entire pollen profile from Drigg 1 suggest possible managed woodland, with fern growth in more, open, possibly cleared areas. The striking increase in willow and sedges, especially clear in Drigg 2, suggests wetter local environments. This interpretation is supported by the consistent presence of bog moss spores and *Copepoda*. A similar trend seen by Pennington (in Cherry & Pennington 1965) is tentatively linked to possible dune migration, causing ponding of freshwater behind the dune system. The wetter assemblages may suggest rising water tables which could also be a response to changes in local coastal drainage. (Dune slacks at present day Sefton on the Cumbria coast support dwarf willow and sedge vegetation – the effect of local hydrology cannot be ruled out). Tipping (1984) at Williamson's Moss described Mesolithic to Neolithic disturbance of alder carr (either natural or anthropogenic) leading to increased proportions of *Salix* and fen-carr herb pollen and suggests this may have been a response to anthropogenic clearance within damp woodland. The lower part of this Zone has been dated to the Bronze Age by correlation to the main exposure (Marshall 2009, 2011).

This final palynoevent seen only in Drigg 2 is one of possibly managed woodland with open, grassy spaces. A relative lowering of the water table may account for less willow and sedge pollen. The assemblage is similar to that described by Pennington (in Pennington & Cherry, 1965) and is probably related to sustained forest clearance. A charcoal-rich primary fill from a Burnt Mound on the Isle of Man which has been dated to the Bronze Age also records a phase of clearance of already light oak-alder-hazel woodland (Gonzalez *et al.* 2000).

The data support a palaeoenvironmental history at this site that indicates possible low scale anthropogenic influence throughout PAZ 1 (charcoal, presence of open areas within woodland) probably from Mesolithic times. A more favourable, drier environment possibility linked to water table movements leading to enhanced growth of birch trees may have been a trigger attracting Late Neolithic - early Bronze Age people to the site (PAZ 2). Archaeological evidence clearly points to the presence of people (hearth) at the site during this time. The palaeoenvironmental record then shows a demise of birch woodland which may be attributed to initial clearance and/or may reflect changing hydrological conditions (PAZ 3). Although the palaeoenvironmental evidence points again to wetter environments (PAZ 4), alder woodland never regains the higher values of earlier pollen zones, suggesting possible woodland management and the continued presence of people in the landscape (PAZ 5). Small scale woodland clearance episodes dated from the early to mid Bronze Age are typically described from south Cumbrian sites, with increased vegetational disturbance events during the mid- to late Bronze Age (Wimble *et al.* 2000).

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