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# The Pennine Lower and Middle Coal Measures formations of the Barnsley district

Geology & Landscape Southern Britain Programme

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BRITISH GEOLOGICAL SURVEY

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# Foreword

This report provides a new appraisal of the Westphalian geology in the Barnsley district, from the Whinmoor Coal in the Pennine Lower Coal Measures Formation up to the Cambriense (Top) Marine Band, which marks the base of the Pennine Upper Coal Measures Formation. It is based largely on a Continuous Revision resurvey carried out on a 1:10 000 scale mainly in the period 1996 to 2000, led by R D Lake. Figures referred to in this report are collated together at the back of the report. This report was written by R D Lake and prepared for release by E Hough and provides supplementary details to the Barnsley Sheet Explanation (Hough, Lake and Hobbs, in prep).

# Contents

## FIGURES

# 1 Introduction

## 1.1 HISTORY OF RESEARCH

The district covered by Sheet 87 Barnsley was originally surveyed on the 1:10 560 County Series sheets Yorkshire by W T Aveline, A H Green, TV Holmes, R Russell and J C Ward, and published on the 1:63 360 Old Series sheets 87 SE and SW in 1863 and 1878. An account of the geology of the district was given within a memoir by Green et al. (1878). A brief description of the Barnsley district was also published in the same year. The district was resurveyed on the 1:10 560 County Series sheets by C N Bromehead, G H Mitchell, J V Stephens and D A Wray in 1929 to 1933 and published as a Solid with Drift edition in 1942. A descriptive memoir was published in 1947, and a supplement in 1954.

## 1.2 LITHOLOGIES

The Coal Measures consist of sequences of interbedded grey mudstone, siltstone, sandstone, seatearth and coal. The measures above the Whinmoor Coal are about 1150 m thick in the Barnsley district of which the highest beds (Pennine Upper Coal Measures Formation) are largely unproductive and up to 320 m thick. Red measures occur in the highest preserved beds in the sequence.

The sandstones consist mainly of subangular to subrounded quartz, with some feldspar and a minor mica content. Coalified plant fragments are common, especially on micaceous bedding surfaces. The grain size is generally very fine to medium, with minor coarse-grained and pebbly units occurring locally. The bases of many sandstone units are erosional. The sandstones are grey when fresh, but commonly weather to yellowish brown flaggy pieces, giving a characteristic field brash at outcrop. The old mining terms 'rock', 'galliard', ‘rag’ and 'strong stone bind' are synonymous with sandstone.

The siltstones are typically medium grey and contain plant debris. They grade both vertically and laterally into sandstones and mudstones and are commonly intimately interbedded with both. Approximate equivalent mining terms include 'stone bind' and 'slaty stone'.

The sandstones and siltstones relate to a variety of fluviatile environments of deposition including distributary channels, crevasse splays and channels, overbank flood basins and lacustrine delta fronts. Coarsening-upwards sequences generally indicate crevasse splays or minor deltas; large-scale examples are associated with the delta front environment.

The mudstones are generally grey to black and weather to a stiff to firm, orange-brown mottled pale grey clay. Some beds contain nonmarine bivalves. Nodules of ironstone are common, ranging in size from a few millimetres up to 0.5m. Mining terms for mudstone include 'bind', 'clod', 'dirt' or 'grey metal' and, for carbonaceous fissile lithologies, ‘scale’ and ‘bat’. Mudstones may have been deposited in a number of environments including lakes and fluviatile overbank or prodelta areas; they are also interbedded with the coarser lithologies or form part of coarsening-upwards sequences.

Marine bands are rare thin beds of black mudstone with a marine fauna, generally occurring close above a coal or a seatearth. They are normally a few centimetres thick but may rarely attain thicknesses of several metres. They commonly grade upwards into grey-black mudstones with a nonmarine fauna. They are recognised across large areas and are important, isochronous marker horizons, particularly as they generally give a characteristic high gamma-ray response in downhole logs.

Seatearth is the name given to fossil soil profiles (palaeosols) which commonly underlie coal seams. Seatearths may be useful for correlation indicating, as they do, a period of relative emergence. They are developed in various lithologies and are characterised by the presence of rootlets. In general, the soil-forming processes have destroyed primary sedimentary structures. The equivalent old mining terms for mudstone seatearths are 'clunch', 'fireclay' or 'spavin'. Where developed in sandstone, seatearths include compact quartzites termed ‘ganister’.

Coal seams are numerous, and some can be traced over long distances. They vary laterally in thickness and composition, chiefly by variation in the number of dirt partings present within the seam. Where partings are present, the separate coals, known as leaves, may be individually named. Seam splits are also common, and individual leaves or entire seams may die out laterally.

Two major facies associations have been recognised within the Langsettian and Duckmantian (formerly Westphalian A and B) strata of the Pennine Basin (see for example, Guion and Fielding, 1988), demonstrating deposition in ‘lower delta plain/shallow water delta’ and ‘upper delta plain’ environments. The former is characterised by several laterally extensive marine bands and ganisters appear to have been preferentially developed as well-drained, podzolic palaeosols in the same situation (Besly and Fielding, 1989, p. 315). Thick peat accumulation, which gave rise to economically useful coal seams, was favoured in the upper delta plain environment.

Guion and Fielding (1988, fig.13.14) also recognised several controls on sedimentation: a large-scale control by major delta switching or marine transgression, a medium-scale effect by a combination of compaction and tectonically induced subsidence, and a small-scale control by local fluviatile and deltaic processes. The medium-scale effect of fault movement is known to influence the thicknesses of sedimentary sequences, the quality and integrity of coal seams and the positions of channel deposits. In the Wakefield district, it can be demonstrated that the Morley-Campsall fault zone and other faults influenced sedimentation to varying extents with time (Lake, 1999). On a smaller scale, the presence of sandstone bodies may have created contemporaneous topographic highs above which thinning of coals or condensation of sequences may have occurred (Bedrock, 1984, fig. 5.21; Cochrane, 1991).

## 1.3 THICKNESS VARIATIONS

The thickness variations of selected parts of the Coal Measures in the Barnsley district are shown in Figures 1-5. There is insufficient information to compile below the level of the Top Thorncliffe Coal. The isopachytes each show an overall thickening to the west or south-west. Minor irregularities of trend are apparent in the lower part of the succession, but there are few perturbations in the plots for above the Barnsley Coal.

Areas of more pronounced thickening in the Thorncliffe-Top Haigh Moor coals sequence (Figure 1), in the extreme north-east and central southernmost tract, may reflect proximity to the Morley-Campsall fault zone and Don Monocline, respectively.

## 1.4 SANDSTONES

The distribution of selected sandstones within the district is shown in Figures 6-9. These plots are, of necessity, generalised because most of the sandstone bodies comprise more than one component and consequently precise contouring is not possible. The broad distribution patterns for the selected sandstones appear to show few similarities, except for some aspects of those of the Glass Houghton and Mexborough rocks.

## 1.5 CONTROLS ON SEDIMENTATION

In the Wakefield district, Edwards et al. (1940, p 15) noted the apparent coincidence of some sedimentary features, particularly coal splits, with the Morley-Campsall fault zone. These were further detailed by Lake (1999, fig. 14).

In the Barnsley district, the splits of coal seams appear more gradual and less clear-cut in nature. With some exceptions, the splits depicted in Figures 10-12 give rise to comparatively thin separations of the individual leaves. Some examples, such as those of the Beamshaw coals as depicted in Figure 12, largely relate to the presence of intervening sandstone(s). Elsewhere in the succession, some seams show significant lateral deterioration: part or all of the seam may pass into dirt or multiply interbedded dirts and coals. The Dunsil Coal (see below) appears to be an example of the latter.

It is interesting to note that some splits of coals that occur in close stratigraphical proximity have similar alignments locally, but face in contrary directions. Examples of such pairs include Silkstone:Thorncliffe and Thorncliffe:Fenton. This might suggest that facies distributions were autocyclic in origin, being influenced by the compactional control of palaeotopography. However, other close alignments of splits, such as those of the Kent’s Thick and Top Beamshaw coals, relate to more distantly separated seams.

## 1.6 STRATIGRAPHY

Some broad lithostratigraphical differences are apparent within the Coal Measures; these can be recognised, in certain parts of the succession, by aspects such as the characteristics of sandstones, the incidence and thickness of coals, and the presence or absence of marine bands and other shelly horizons.

However, in this account, the succession is divided on the basis of marker bands into Lower, Middle and Upper Coal Measures, taking the respective lower boundaries at the bases of the Subcrenatum and Vanderbeckei marine bands and at the top of the Cambriense Marine Band (Stubblefield and Trotter, 1957). The first two marine bands also delimit the Langsettian Stage, whereas the Duckmantian/Bolsovian boundary is taken at the base of the Aegiranum Marine Band.

An earlier description of the Barnsley district (Mitchell et al., 1947) was later revised in a supplement (Mitchell et al., 1954), to take account of new evidence, revised correlations and also the recognition of certain marker horizons known from elsewhere. At the latter date, the presence of certain other key horizons remained to be proved. These included the Clown(e), Sutton, Edmondia and Cambriense (Top) marine bands as well as some in the lowest Coal Measures. The named bands have now been recognised to varying extents. However, it should be emphasised that more recent deep exploration was largely confined to the easternmost part of the district. The Main ‘Estheria’ Band of Nottinghamshire (below the Shafton Coal) was thought to be ‘masked by a large number of ‘Estheria’ horizons’ (Mitchell et al., 1954, p.187). Two tonstein markers associated with the Sharlston coals were identified in the Doncaster district to the east (Gaunt, 1994); only one has been proved by coring in the Barnsley district.

# 2 Lower Coal Measures

### Whinmoor Coal to Vanderbeckei Marine Band

The sequences Whinmoor-Silkstone and Whinmoor-Swallow Wood coals are illustrated in Figures 13 and 14, respectively.

The **Whinmoor Coal** (Low Beeston Coal) was worked locally at crop and less commonly at depth in the Barnsley district, generally about 1 m thick towards the north. Close to outcrop, this seam and the overlying Black Band and Lousey coals are evenly separated by measures, commonly with sandstone. Mitchell et al., (1947, p.30) noted that the Whinmoor Coal commonly has a roof of sandstone in the north. At depth, northwards from High Hoyland, the coal splits into Top and Low seams: as a result, near Midgley in the Wakefield district, the Top Whinmoor Coal lies within 2 m of the Black Band Coal. The various splits of the Beeston Coal in the Wakefield district are detailed in Lake (1999, fig. 15).

The **Black Band Coal** (Top Beeston Coal), although persistent, is thin and appears largely unworked in the Barnsley district. The **Lousey Coal** similarly is little worked. In the area north of High Hoyland, three thin coal/seatearth horizons occur in the strata between the Lousey and Low Silkstone coals. Southwards, fewer such horizons have been generally recognised in the boreholes that penetrate the sequence, although one locally thicker seam was termed the **'Jack Coal'**.

The **Silkstone Coal** is present as a unified seam in two areas around Barrow and Handsworth (Nunnery) collieries. Here the seam has a thin dirt parting and is generally over 1.5 m thick. The seam was worked preferentially in these areas. The dirt parting separates two bright coals ('bottom softs' and 'top softs'); the upper contains a thin dull coal and is also capped by a hard dull coal ('branch'). In the Barnsley district, a significant split develops to the east of Barrow and the **Top and Low Silkstone coals** are commonly separated by a body of siltstone and sandstone. Here only the top coal was worked, about 0.9 m thick and the separation of the coals may be up to 10 m. In a number of borehole records an euestheriid horizon has been recognised in the measures immediately above the Low Silkstone Coal. This horizon is thought to represent the **Low 'Estheria' Band** of the Wakefield district, suggesting that the Top Silkstone Coal is equivalent to the Blocking Coal of that district.

A thin rider coal is commonly recorded about 5 to 10 m above the top Silkstone Coal. The nodular **Claywood Ironstone** is present in the south, about 12 m above the Silkstone Coal, and with the rider coal at its base. This ironstone was formerly worked to the south-east of Chapeltown and comprises 2 to 4 m of dark grey mudstone with layers of siderite nodules.

The **Silkstone Rock** is present at outcrop throughout the Barnsley district, about 15 m thick. Locally this comprises two units of flaggy, fine-grained sandstone. It thickens southwards as a massive, evenly bedded unit towards Rotherham and is thickest in an east-west-trending tract to the south of Sheffield (Guion et al., 1995). In the northern outcrop, it closely overlies the Silkstone Coal, whereas southwards thick mudstone (up to 20 m) with the Claywood Ironstone intervenes. In the subcrop, it is poorly represented except near the southern margin of the Barnsley district.

The **Silkstone Four-Foot Coal** (Wheatley Lime Coal) lies about 35 m above the Silkstone Coal in the north-west of the Barnsley district; it is thin or not recognised in the south. This seam has been distinguished over much of the southern half of the Wakefield district, but northwards from there it merges with the Middleton Main Coal. In the east of the Barnsley district only sparse and thin inferior coals were encountered in the few boreholes that sampled this part of the succession. Exceptionally, in the Brodsworth shaft, three coals greater than 0.2 m thick were recorded at about this level. However, both the Wheatley Lime Coal and the underlying **Middleton Eleven Yards Coal** were recognised in the Doncaster area to the east (as in the Bentley Colliery No 2 Shaft: Gaunt, 1994, fig. 10),

The **Thorncliffe Coal** (New Hards or Swilley Coal) is the correlative of upper part of the Middleton Main Coal of the Wakefield district (see above) and this was extensively mined north of Wentworth and around Elsecar. It commonly contains a number of dirt partings but one such 'middle dirt' is commonly present and this expands in three areas to form a significant split (Figure 10). This may render the seam worthless, although locally one leaf was still workable. Thus in the northern and western tracts of split coal, the **Top Thorncliffe Coal** is thicker and was worked whereas, in the south-eastern area, the lower seam is commonly thicker. In this last area, the split is much larger, up to 19 m (measured base to base of the coals) and commonly contains siltstone or sandstone.

The name ‘Swilley Coal’ derives from occurrences of the seam in the Silkstone Fall Colliery. Here marked thickness variations of the coal were related to infills of irregular hollows within an underlying sandstone.

Pale grey mudstones with ironstone (**White Mine**) have been recorded above the Thorncliffe Coal between Wharncliffe Silkstone and Thorpe Hesley collieries: the ironstone was worked at depth to the south-east of Thorpe Hesley village (Green et al., 1878, p.274). Another siderite horizon (**Yellow Mine**) occurs close below the Parkgate Coal but there is no record of working.

The highly productive **Parkgate Coal** (a locally derived name) was extensively worked to the south-east of Barnsley, although locally prone to washout by the Parkgate Rock which closely overlies it (see below). The seam commonly comprises three main parts, a bottom and top bright ‘softs’ with a middle ‘hards’ containing some dull coal. To the north-west of Barnsley, the seam splits, as recorded at Wharncliffe Woodmoor Colliery, and the individual thinly separated leaves were worthless. Northwards of Hemsworth, the impoverished seam is recognised with difficulty. In the Sheffield district the seam also splits south-east of Treeton.

The fine-grained **Parkgate Rock** is only thickly present at crop to the south-east of Thorpe Hesley in the extreme south of the Barnsley district. At depth it is over 20 m thick in a broad tract trending north-north-eastwards, with a western margin near South Elmsall. The eastern limit lies near Edlington. In the south-east of the Barnsley district, two sandstone-bearing cycles are locally recognised between the Parkgate and Fenton coals; the respective sandstones locally coalesce. Similarly, the thickest developments as at Denaby Main Colliery (43.6m) may result from the merging of the Parkgate Rock with a sandstone in the cycle above.

The **Fenton Coal** (equivalent to the Deep Hard Coal(s) in the south of the Sheffield district and in the Doncaster district) is thickly developed at depth in the Barnsley area but it splits into **Top (High) and Low** units radially from here (Figure 10). Westwards, towards the crop of the split seam, both leaves were mined either individually or as one according to the degree of separation. Locally as worked near Chapeltown, the **Black Mine Ironstone** is present in the intervening measures, which are up to 6 m thick in the district. In the Barnburgh area, a marked deterioration of the split leaves is noted. In the Doncaster district, the **Deep Hard coals** generally comprise two seams separated by up to 13 m of strata (Gaunt, 1994, p.29). A similar, but thinly separated, development is recorded in some boreholes near the eastern margin of the Barnsley district. Elsewhere, the sequence is uncertain or affected by washout.

In the south of the Doncaster district, the **Deep Soft coals** mainly consist of two seams separated by up to 17 m of strata including sandstone (Gaunt, 1994, p.29). The upper (‘Top Soft(s)’) coal splits locally and both coals are prone to washout. Northwards, the top coal almost certainly passes into the Flockton Thin Coal. A similar development of strata, apparently up to about 30 m thick, is recorded in some boreholes in the south-eastern corner of the Barnsley district but due northwards the succession is unclear or unproven. Elsewhere in this district, the **Flockton Thin Coal** is generally thin and unworked. This coal has been correlated with the upper main leaf of the Sitwell Thin Coal of the Sheffield district (Eden et al., 1957, p.86).

The crop of the **Flockton Thick Coal** was worked extensively in the north-west of the district in conjunction with the overlying Tankersley Ironstone. The coal is thinly split into two leaves to a varying extent throughout much of the Barnsley district. There are few recent cored borehole provings to demonstrate detailed relationships and some correlations of old shaft data are tenuous, particularly southwards where other thin seams occur close by in the sequence, which may include the **Sitwell Coal** of the Sheffield district. South-east of the district, the seam appears locally to remain unsplit. The **Tankersley Ironstone** occurs as nodules and thin seams of siderite, containing abundant bivalve detritus, in mudstone about 5 to 15 m above the Flockton

Thick Coal. The ironstone development may reach 4 m in thickness near crop, not necessarily all regarded as workable in the past.

The **Joan Coal** is a thin but persistent seam. This coal or its seatearth has been recognised in most boreholes in the district.

# 3 Middle Coal Measures

The succession between the Vanderbeckei Marine Band and Swallow Wood Coal is shown in Figure 14. The **Vanderbeckei (Clay Cross) Marine Band**, which marks the base of the Middle Coal Measures and forms the roof to the Joan Coal, is generally, but not exclusively, much less than 1 m thick. It was not identified in all areas, particularly in the older part of the coalfield, where its significance was not appreciated by the shaft sinkers. It is typically a dark grey silty mudstone with *Lingula* and fish remains.

Locally as at Darton Main Colliery a thick, fine-grained sandstone is present in the overlying beds. This is the local equivalent of the **Thornhill Rock** of the Wakefield district. In the measures above, a coal up to 0.4 m thick has been recorded locally that may be equivalent to the **Second Ell Coal** of the Sheffield district.

The **Lidget Coal** lies about 40 m above the Vanderbeckei Marine Band. A number of coals occur near this level and precise correlation is consequently uncertain in some areas. The Lidget Coal has generally been taken to be the thickest of these.

In the earlier description of the Barnsley district (Mitchell et al., 1947), the Top Haigh Moor Coal and the Swallow Wood Coal were regarded as the same seam and hence subject to confusion, later rectified in a supplement (Mitchell et al., 1954). In a broad tract north of Barnsley Main Colliery [3649 0603], the **Haigh Moor Coals** comprise two thinly separated components, **Top and Low** (Figure 11). Southwards and westwards the seams diverge; both seams were mined in that northern tract and westwards to varying extents. Southwards from Barnsley Main Colliery both seams deteriorate and the Top Haigh Moor Coal is subject to washout. This washout is caused by the Haigh Moor Rock in a north-east-trending area near Grimethorpe. Other small areas of washout have been recognised nearby and, north-eastwards, sandstone is present in localised seam splits. Farther south, another washout would appear to be extensive eastwards of Barrow Colliery. This must also be due to the Haigh Moor Rock, perhaps in a thin development, but the locally named and thick **'Birdwell Rock'** (up to 24 m) at this level possibly results from the coalescence of the former rock with a sandstone lower in the sequence. There is only limited borehole information relevant to this feature.

In the southern part of the district, to the north of Silverwood Colliery, the Top and Low Haigh Moor Coals are also thinly separated. Both coals are also relatively thinly split hereabouts but they deteriorate as internal splits increase to the west of here.

Mainly in the Wakefield district, the **Haigh Moor Rock** appears to consist of a single sandstone body, occupying a fairly well-defined channel system. This sandstone is locally over 20 m thick in the north-west of the Barnsley district (Figure 7). In the southernmost part of the district a local correlative is thinly present, about 5 to 10 m thick. The thickness may be apparently enhanced where the sandstone within the Swallow Wood split (see below) is in close juxtaposition. In the intervening tract of country, the 'Birdwell Rock' has been identified in some shaft records (see above).

In the south-western part of the Wakefield district, particularly near Ossett, several closely spaced coals of similar thickness are present in the beds above the Haigh Moor Coal. The lowest of these, the **Swallow Wood Coal** (14 Yard Coal), is possibly the most persistent. It may be recognised locally by the presence of ooidal ironstone in the beds immediately above it (Scott, 1978, p.465;

Deans, 1936; Edwards et al., 1940, pp.13, 61). The succeeding named coals are the **27 Yard Coal** (locally split into two or three leaves), the **Gawber Coal** (locally subject to washout) and the **Beck Bottom Stone Coal** (up to 1.3 m thick and locally in two leaves up to 5 m apart). In areas where the Horbury Rock is not strongly developed, the next coal in the succession is the **Dunsil Coal**. This name has been widely applied, but not always to the correct seam.

In the north-west of the Barnsley district, the persistence and correlation of the coals above the Swallow Wood Coal is uncertain. Sandstones are well developed in the sequence as locally to the east and possibly may be responsible for local washouts: those include a thin correlative of the **Horbury Rock**. To the west of Gawber [326 073] however, a thin coal (‘Swallow Wood Marker’) was mapped between the Swallow Wood Coal and a thinly split Gawber coal and thin coals each occur above the latter and the Dunsil Coal. Only the Swallow Wood Coal was traced south-eastwards to Worsbrough, although the Dunsil Coal was recognised at depth eastwards.

The **Swallow Wood Coal** of the Barnsley district is commonly split by two thin dirt partings. This split is more evident in the Barnburgh area [4771 0320]. A more marked split occurs in the Sheffield district, south of Silverwood, where a thin sandstone intervenes. Near Frickley [4680 0962], the coal closely overlies the Top Haigh Moor Coal, effectively merging with it, although dirt partings are present within the combined sequence. Elsewhere near the northern margin of the Barnsley district, the seam is generally impoverished.

The sequence between the Swallow Wood Coal and the Aegiranum Marine Band is illustrated in Figure 15. Of the generally thin coals that occur between the Swallow Wood and Barnsley coals, the highest and thickest is the thicker **Dunsil Coal**. This coal commonly splits into a number of leaves and locally the local term **‘Harley Coal’** appears to have been applied (by opencast operators) to the main (workable) components of the Dunsil Coal. The term ‘Dunsil’ has also been restricted to only a topmost thick leaf at some opencast sites; elsewhere the name ‘Harley’ was applied to a coal lower in the sequence.

The dirt separations are thinnest in a tract between Cadeby Main and Bullcroft Main collieries. North of Barnsley the seam is much split and deteriorated. Up to at least nine separate coal leaves of the Dunsil Coal were noted in boreholes near Upper Haugh [SK42 98] and, hereabouts, a thicker dirt parting (up to 1 m thick) can be used for correlation and subdivision into ‘Upper’ and ‘Lower’ components. At depth south-eastwards, detailed correlation of the various leaves appears impracticable whereas, to the south at Tinsley in the adjoining district, a significant 5 m-split appears to develop. Eastwards in the Doncaster district, the Dunsil Coal effectively merges with the Barnsley Coal, as at Markham Main Colliery No 1 Shaft (Gaunt, 1994, fig. 13).

The **Barnsley Coal** was the most important seam in this part of the Yorkshire Coalfield. It comprises three components: an upper 'Top Softs' unit above a semi-anthracitic 'Hards' coal, which overlies a bituminous 'Bottom Softs' (or 'slotting') coal. Worked thicknesses of around 2 m are typical and the coal is generally of uniform composition throughout the Barnsley district. North of the River Don, an inferior coal (‘the clay seam’) is present between the ‘Hards’ and the ‘Top Softs’. This clay seam is commonly overlain by a bed of mudstone and dirt. Northwards from near the district margin to about High Ackworth in the Wakefield district, this bed thickens considerably so that the Top Softs unit splits away and effectively joins with the Barnsley Rider Coal to form the **Warren House Coal**. The Hards/Bottom Softs unit continues north from the line of split as the Low Barnsley Coal but this is extensively washed out as a result of erosion beneath the topmost component of the Horbury Rock.

The **Barnsley Rock** is commonly present as a thin sandstone or siltstone between the Barnsley Coal and the Barnsley Rider Coal. It is thicker (over 10 m) in an area near its crop west of Rawmarsh and south-eastwards from there at depth (Figure 7).

The **Kent’s Thick Coal** commonly contains a thin dirt parting, which locally thickens to give a significant split. This is marked (up to 10 m) in the area around Cortonwood [4067 0143] and hereabouts the upper coal is the thicker. In the south-east of the Barnsley district and southwards, the seam separation is enhanced by the presence of sandstone (Figure 12), although correlations are less certain there.

The **Kent's Thin Coal** is a persistent, thin seam that was only worked near outcrop on a local scale (see also below). The overlying **Kent's Rock** is over 10 m thick in north-west Barnsley, where it is best developed at crop.

The **Beamshaw Coal** (Stanley Main Coal of the Wakefield district) is split into two leaves throughout much of the district, the Top Beamshaw or Kilnhurst Coal and the Low Beamshaw (or simply 'Beamshaw') Coal (figure 12, 16 a and 16b). The two coals are only closely associated, with numerous dirt partings, to the east of Frickley. Here the combined coal has been termed the **'Hatfield High Hazel Coal'**, as recognised in the Doncaster district to the east (Gaunt, 1994). The lines of two prominent splits intersect in this area. The generally thin split within the Top Beamshaw Coal develops northwards and, elsewhere for the most part, westwards. That within the Low Beamshaw Coal is locally quite marked and increases southwards and eastwards. The combined effects of the two splits cause the interseam separations between the highest and lowest separate coals, base to base, to be fairly constant at about 10 m, with local exceptions. For example, marked variations have been observed within the confines of one opencast coal working.

Near Rotherham, at crop along the line of the Don Monocline, and south-westwards to Sheffield, the more persistent and thicker, lower leaf of the Low Beamshaw Coal and the Kent's Thin Coal merge to form the **'High Hazles Coal' of Sheffield** (see also Wilcockson and Goossens, 1957). Here sandstones are common within the splits and the interseam separation (upper Top Beamshaw to High Hazles Coal) is locally over 20 m.

The locally named **Abdy Coal** was worked locally from crop and shallow shafts. It is subject to washout in the south near Kilnhurst and Denaby Main collieries. In places a thin coal occurs between this coal and the Top Beamshaw Coal. The **Abdy Rock** is best developed at crop to the east of Hoober (over 25 m thick) and locally causes washout of the underlying Abdy Coal. At Denaby Main this sandstone is 26.4 m thick and it persists eastwards.

The **Two-Foot Coal** is a fairly persistent seam although only worked locally. It tends to be thinly split in the area around Frickley.

The **Maltby Marine Band** (Two-Foot Marine Band) occurs in the roof measures of the Two-Foot Coal and is typically represented by black carbonaceous mudstone with *Lingula*, locally over 1 m thick. The band is thickest (over 2 m) near Bullcroft and Brodsworth, where the underlying coal is predominantly of cannel.

The **Meltonfield Coal** was extensively worked near outcrop and typically comprises a 'main' coal and a thinner bottom coal, locally separated by dirt. A significant split occurs within the main coal towards the eastern margin of the Barnsley district, and the lower leaf is subject to local washout. In places, the seam is closely overlain by the Woolley Edge Rock, but it appears little affected by washout, in contrast to the situation in parts of the Wakefield and Goole districts to the north.

The **Manton 'Estheria' Band** has only been noted in the east-central part of the district, having been proved in recent boreholes which show it to comprise black mudstone, up to at least 4 m thick, with ironstone, euestheriids and bivalves, overlying a seatearth. In other areas it may have gone unrecognised or may have been washed out by the overlying Woolley Edge Rock.

The **Woolley Edge Rock** is a thick, multistorey sandstone, which passes laterally into siltstone with thin sandstone beds. In the Wakefield district, it occupies a tract 15 km wide from east of Knottingley, through Pontefract, Wakefield and Ackworth [445 175] to Woolley [320 131], as proved by numerous boreholes. In the Barnsley district, it is thickly present at crop south-eastwards from Woolley to near Rainborough Park [401 000]. At depth it is over 20 m thick to near easting 43, that is the longitude of Great Houghton (Figure 8). Locally it approaches a thickness of 40 m. In the eastern part of the district, it is represented by thin leaves of siltstone and sandstone within mudstone.

The **Newhill Coal** varies markedly in development and quality, and may be locally absent (in some cases due to washout). Consequently the coal has been little worked although it is about 1 m thick and contains little dirt in places. A localised split is present, up to 6 m, near Grimethorpe, although the seam was not recorded at the colliery shaft.

*Lingula*-bearing mudstone, up to 2.1 m thick, correlated with the **Clown(e) Marine Band**, has been recorded from the district to the east (Gaunt, 1994) and in the south-east of the Barnsley district, south of Conisbrough, where it occurs in the roof of the Newhill Coal. In some other provings in the Barnsley district near Darfield, black and dark grey mudstone with bivalves occurs at this level. Otherwise, lack of workings in the underlying coal may account for the paucity of recordings of the marine band. It has been noted (Gaunt, 1994, p.43) that the distribution of the *Lingula*-bearing bed appears to reflect the presence of an impoverished Newhill Coal, commonly with cannel in its upper part.

The **Swinton Pottery Coal** is generally thin and of poor quality, and is commonly split into two or more inferior coals. In the east a single seam is present. This level of the succession is noted for the workable seatearth beneath the coal, which has been used in brick and pottery manufacture around West Melton and Swinton.

Regionally, the succession above the Swinton Pottery Coal contains up to three thin coals and two marine horizons, the *Lingula*-bearing Haughton and Sutton marine bands. Elsewhere, subsequent deposition of the Oaks Rock may have washed out all or part of this sequence. Hence, in the Barnsley district, these horizons are all only preserved in the easternmost area (see below). The **Haughton Marine Band** (‘Swinton Pottery Marine Band’) was recognised at outcrop in the West Melton brickpit (Mitchell et al., 1947, p.74), 12.8 m above the Swinton Pottery Coal. In the cored Shortwood Lane Borehole near Clayton, this band is 0.8 m thick. Farther east, northwards of Sprotbrough, 3 to 4 m of beds have been recorded. Near Treeton Colliery to the south of the district, up to 2.5 m have been cored. The **Sutton Marine Band** appears not to have been recognised in boreholes in the exposed coalfield of Barnsley; gamma-log traces indicate localised occurrences in the concealed area. It was proved, 2.1 m thick, in a cored borehole near Treeton Colliery to the south (Spa Hill No 2).

The **Oaks Rock** in the Wakefield district is developed in the south-central area with an eastern limit running near Purston Jaglin to North Elmsall. The sandstone here occurs as a single unit or as two well-defined leaves. In the Barnsley district, this unit is thickly present at crop (over 30 m in places) and is present at depth (generally over 20 m thick) in a broad embayment extending to the east of Brodsworth (Figure 8). In the latter area and in the south-east, the sandstone is typically developed at a level below the Sutton Marine Band. It thins southwards near Rawmarsh, in the vicinity of the Don Monocline.

The **Wheatworth Coal** which lies close above the Oaks Rock is variously split and of poor quality or not recognised in the Barnsley district.

The ubiquitous **Aegiranum (Mansfield) Marine Band** marks the base of Bolsovian (Westphalian C) measures and is well documented in many recent boreholes, producing a marked gamma-ray spike on electric logs. It comprises dark grey mudstone and bioturbated siltstone with rare layers of impure limestone or calcareous siltstone, and commonly overlies a thin coal and seatearth. In the Barnsley district, a hard, cemented ‘cank’ horizon has been recorded at this stratigraphical level at a number of localities. Exposures include those recorded at brickpits at Monk Bretton, Stairfoot (extant type locality), Park Hill and Manvers Main. Mitchell et al. (1947, pp.76-77) recorded the thicknesses of beds with a marine fauna as 0.41 m, 0.91+ m, -, and up to 1.07 m respectively. The section at Stairfoot [3813 0492] was recorded in 1998 as follows:

| Thickness (m) | |
|---|---|
| Mudstone, dark grey | 1.0+ |
| Cank: a line of large flat carbonate nodules | 0.3 |
| Mudstone, grey, micaceous, fairly fissile; goniatites seen in the top part | 0.9 |
| Mudstone, fissile, black | 0.01 |
| Coal | 0.05 |
| Seatearth mudstone, pale grey, with small, irregular, ironstone nodules | 0.3+ |

The marine band appears to be over 1 m thick, with *Lingula* and *Dunbarella*, in a few cored sections available (in the Darfield-Wath area). However, north-west of Sprotbrough, nearly 3 m of beds were described whereas 8 m of strata were electrically logged in the Womersley No 2 Borehole to the north of the district.

The sequence above the Aegiranum Marine Band includes the Houghton Thin Coal and the Sharlston group of coals (Figure 17), and two sandstone units, the Ackton Rock and the Glass Houghton Rock. The Glass Houghton Rock and laterally equivalent sequences were studied by Bedrock (1984). The **Ackton Rock** (formerly Warmfield Rock of Edwards et al., 1940, p.84; Lake, 1999, p.48) is well developed at outcrop near Swinton (about 12 m thick). It apparently has a linear occurrence eastwards through Denaby and may be analogous to the **Treeton Rock** in the area to the east of Sheffield. In the Wakefield district the Ackton Rock is most thickly developed at depth (over 20 m) in a tract running north-east from Hemsworth to Knottingley.

Largely unrecognised at outcrop in the Barnsley district, the **Houghton Thin Coal** (Second Wales Coal) closely overlies this sandstone and is generally thin. The **Sharlston coals** are a variable group of thin coals, important in opencast mining near the northern margin of the Barnsley district. Locally, they are washed out by (or pass laterally into) the **Glass Houghton Rock** and their preservation is thus related to the development of this and a higher sandstone unit.

The Glass Houghton Rock in the Wakefield district apparently occurs as two main units, which merge to form a unit up to 50 m thick, at outcrop at Glass Houghton and at depth between Ackworth Moor Top [44 16] and north-east of Knottingley. The lower component persists as a thick unit to the south-east of this tract, whereas the thick upper component extends south-westwards from Ackworth through Hemsworth. Where the thinnest developments occur near the outcrop between Cold Hiendley [37 14] and Sharlston, the Sharlston coals are better preserved. In the Barnsley district, the thick (over 20 m) upper unit persists at depth to the west of easting 430, and also, as multiple leaves, in a north-easterly aligned tract through Adwick le Street (Figure 9). The former occurrence comes to crop northwards from Ardsley and is apparently faulted out to the east, south of Darfield. The second tract may also be faulted out in the Dearne valley.

The outcrops of the Sharlston coals are somewhat restricted by drift cover and the effects of strike faulting. The thicker developments occur in the north of the district. Close above the Houghton Thin Coal, the **Sharlston Yard Coal** (First Wales Coal) occurs as a single seam in the area between Sharlston and Hemsworth in the Wakefield district, rarely with a seatearth parting. To the south-west (as at Grimethorpe Colliery) and north-east, splits develop (Bedrock, 1984, fig. 5.1), reaching a maximum of 8.1 m in the Sidcop Road Borehole near Upper Cudworth [3850 0996]. The onsets of the splits are difficult to define, and the scale of the separations appears to be controlled by the presence of intervening sandstone. To the south-east of Thurnscoe, the coal is thin or absent, although it is present (along with the most of the other Sharlston coals) at depth in the extreme south-east of the Barnsley district.

The **Sharlston Thin Coal** is thin both in the north of this district and in the Wakefield district. It occurs about 3 to 8 m below the **Sharlston Low Coal**, but appears poorly preserved and is not recognised in the south of this district. The latter, locally over 1 m thick in the north of the district, shows a localised split with intervening sandstone at depth in an area around Frickley Colliery.

Bedrock (1984, p.224) thought that the sandstone may relate to a lobate crevasse-splay. Also at depth, the seam is subject to total washout in a belt trending north-north-east through Hemsworth and Brierley; partial washout occurs elsewhere (Bedrock, 1984, fig. 5.13; Lake, 1999, fig.26).

The **Sharlston Muck Coal** is less well-recognised than the Sharlston Low, although it serves as an important marker, because it is associated with a tonstein horizon (Figure 17). The coal is subject to washout in an area comparable with that of the Sharlston Low Coal, but hereabouts the removal is complete. The tonstein represents ash deposits from an acid volcanic source (Spears and Kanaris-Sotiriou, 1979). Price and Duff (1969) gave some details from within the region, notably at Gap Lane Opencast Site II [376 211], Warmfield. The tonstein is a dense, kaolinitic mudstone layer about 25 mm thick, and pinkish brown in colour. It occurs variously below, within or above the coal. It has been recognised, mainly by its gamma-ray response, in boreholes in the south-eastern part of the Barnsley district and north-east of Great Houghton. Examples at the same stratigraphical level to the tonsteins of the Sharlston coals were described by Eden et al. (1963), below and within the High Main Coal of Nottinghamshire and Derbyshire.

The thickness of the **Sharlston Top Coal** (Cudworth Coal, Double-Smuts Coal) apparently varies inversely with that of the underlying Glass Houghton Rock (Bedrock, 1984, p.248). It is thickest (over 1 m) in the Frickley area and locally near Hemsworth and is in places thinly split by dirt partings. Generally this is the best developed of the Sharlston coals and has been worked opencast locally in the district. The seam characteristically deteriorates in quality downwards and locally the lower part passes into dirt, causing an abrupt thinning of the seam (Graham, N.C.B. data). The seam is thin in the south-eastern part of the district. A tonstein is also associated with this coal in the Doncaster district to the east as noted in the Spital Croft Borehole (Bedrock, 1984, p256), and tentatively in the Wilsic Hall and Shaftholme Grange boreholes (Gaunt, 1994, p48).

The **Edmondia Marine Band** has been recognised widely in recent exploration boreholes in the district. It commonly forms the roof to an inferior coal, and consists of dark grey, bioturbated mudstone with foraminifera. *Lingula* has been recorded locally. It is overlain by paler grey mudstones with ironstone and *Planolites*. Thicknesses apparently vary up to over 4 m. Regionally, euestheriids have been noted locally in mudstones subjacent to this bed, and their occurrence can provide an alternative marker horizon, where the marine fauna is poorly represented.

The **Mexborough Rock** of the Wakefield district is thickly developed in two areas as interbedded sandstone and siltstone, firstly in a sinuous tract between Darrington and North Elmsall, and secondly in the Ryhill-Hemsworth area. Thicknesses of about 20 m are common, but may exceed 30 m in places. In the Barnsley district, the main occurrence is a continuation of the latter and this lies in a broad zone extending from the outcrop eastwards (Figure 9; see also Aitken et al., 1999). Locally this sandstone is over 30 m thick, possibly where the sandstone merges with a lower unit. The expected continuation of the tract at North Elmsall is not discernible from the borehole data: possibly this is also a composite unit in the northern district and exists as two separate thin leaves hereabouts. The composite nature of this rock unit (formerly known as the Rotherham Red Rock) is clearly evident to the east of Conisbrough where boreholes show a passage from thick Mexborough Rock to several cycles, each capped by a thin seatearth sandstone.

The **Shafton Coal** is an important seam, typically over 1 m thick in the north of the Barnsley district, and was mined extensively north of Barnburgh Main Colliery. The crop is commonly marked by former shallow workings. The coal is thinly split to the east of Brodsworth, and is thinner in the south-east of the district. In the beds above, two euestheriid horizons occur close below the succeeding marine band.

The succession above the Shafton Coal is shown in Figure 18. The **Shafton Marine Band** has been recognised quite widely in boreholes in the district, and even in some colliery sinkings (Culpin, 1909), typically comprising up to 7.5 m of grey to dark grey mudstones with ironstone nodules. The fauna comprises *Lingula*, *Edmondia,* and other bivalves. Regionally, some of the thicker sequences include sandstone or siltstone, and barren strata may separate two units with marine fossils (Gaunt 1994, p.49).

The beds between the Shafton and Cambriense marine bands contain up to five shelly horizons with *Naiadites* and euestheriids, as in the Sun Inn Borehole to the east of the district (Gaunt, 1994, p.49), and the Highgate Coal. The lowest euestheriid horizon directly overlies the Shafton Marine Band, as noted in several cored boreholes in the Barnsley district.

The **Highgate Coal** (as locally named) is apparently a persistent coal (about 0.5 m thick) in the exposed coalfield of Barnsley and southwards but it thins towards the northern margin of the district and it is not distinguished in the Doncaster district to the east.

The **Cambriense (Top) Marine Band** comprises dark grey mudstone with ironstone nodules, burrow-fills and *Lingula*. Up to 4 m are apparently present at, or closely below, the erosional base of the Ackworth Rock. However, this horizon has been recognised in few electric logs of boreholes, particularly in the north of the district, which suggests that it is generally thin or washed out. In the Doncaster district, it is similarly subject to partial or total washout (Gaunt, 1994, p.50). Regionally, it may occur above dark grey mudstones with euestheriids.

# Appendix 1 Thickness of coal beds

## **COAL THICKNESS: SE SHEETS** (*: with significant dirt partings)

| COAL SEAM | SE30 | SE40 | SE41S | SE50W |
|---|---|---|---|---|
| HIGHGATE | 0.7 | 0.2-0.6 | thin | 0-0.7 |
| SHAFTON | 1.4-1.7 | 1.0-2.0* | 0.6-2.2* | 0.9-2.3* & split |
| SHARLSTON TOP | 0.7-1.1 | 0.5-1.9* | 0.5-1.4 | thin-1.3* & split |
| SHARLSTON MUCK | | 0-0.8 | 0-thin | 0-?0.5 |
| SHARLSTON LOW | 0.3-0.8 | 0.5-1.4 & split | 0-2.6* | 0-0.8 |
| SHARLSTON YARD: FIRST WALES | ?0.3+0.2 | 0.4-1.2* & split | 0.7-1.0 | 0-?0.5 |
| HOUGHTON THIN: SECOND WALES | | 0.1-0.5 | 0.1-0.6 | 0-?0.8 |
| WHEATWORTH | 0-2.4* | Thin-1.3* | 0.1-0.4 | 0-?0.9 |
| | ?no WO | | | |
| SWINTON POTTERY | thin | 0.1-1.2* | 0.2-1.3 | 0.2-0.6 |
| NEWHILL | 0.3-1.4 | ?0-3.0* & split | 0.2-2.9* | 0.7-1.3 |
| MELTONFIELD | 0.7-1.3 | 0.5-1.5 | 0.3-1.5 | 1.3-1.7* & split |
| TWO-FOOT | 0.6-1.5* | 0.2-2.1* & split | 0.2-1.3* | thin-1.3* & split |
| ABDY | 0.8-1.7* | 0.5-0.9 | 0.7-1.3* | 0.8-1.9* & split |
| TOP BEAMSHAW | thin-1.8* | 0.3-2.7 (HHH) | 0.3-1.6* | 0-2.9* (HHH) |
| LOW BEAMSHAW (main lower) | 0.5-0.6 | 0.4-1.1* | 0.6-1.2 | 0.3-1.0 |
| KENT'S THIN | 0.3-1.5* | 0.2-0.7 | 0.1-0.9 | 0-0.3 |
| KENT'S THICK | 0.7-2.3* | 0.5-2.1* & split | 0.7-1.2 & split | 0.3-0.9* 0.2-0.7 |
| BARNSLEY | 1.7-3.1 | 2.3-3.1 | 2.6-3.9* & split | 1.7-.3.0 |
| DUNSIL | 0.5-2.9* | 0.7-2.4* | 0.3-3.3* | 0.9-2.2 |
| Coal, thin | 0.7 GAWBER | | | |
| SWALLOW WOOD | 0.2-3.7* | 0.6-2.2* & split | 0.5-2.5* | 0.6-2.1* |

| | | | | |
|---|---|---|---|---|
| TOP HAIGH MOOR | 0.3-2.4* | 0-2.3* | 0-1.5 | 0-0.4 |
| LOW HAIGH MOOR | thin-1.4* | 0.2-1.6* & split | 0.4-2.6* | 0-? |
| LIDGET | 0.3-1.5* | 0.3-0.9 | 0.3-0.8 | ?0.7* |
| JOAN | thin-0.7 | 0-0.8 | 0.5-1.4* | 0.2 |
| FLOCKTON THICK | thin-2.9* | 0.4-1.5* & split | 0.2-2.3* | 1.6* |
| SITWELL | | | | |
| FLOCKTON THIN | 0.3-2.0* | Thin-0.3 | 0-0.9* | |
| FENTON | 1.0-2.7* & split | ?0-3.1* & split | 0.6-2.0* & split | 0.4 & split<br>0.3-0.4 |
| PARKGATE | 0.4-3.9* & split | 0-2.4* | 0.5-2.3* | 0-2.3* |
| THORNCLIFFE | 0.3-2.2* & split | 0.2-3.1* & split | 1.1-2.1* | 0.1-2.2* & split |
| SILKSTONE FOUR-FOOT | 0-1.6 | Thin if present | 0.5-1.3* | |
| SILKSTONE (TOP, where split) | 0.6-2.2* | 0.8-1.4 | 0.4-1.2 | 0.9-1.1 |
| LOUSEY | 0-0.6 | Thin-0.7 ?and split | | |
| BLACK BAND | 0.3-1.3* | 0.2-0.5 | 0.5-1.1 & split | |
| WHINMOOR | 0.5-1.8* | 0.2-1.2 | 0.5-1.5* | |

**Abbreviations: HHH = Hatfield High Hazels**

**COAL THICKNESS: SK SHEETS** (*: with significant dirt partings)

| COAL SEAM | SK39 | SK49 | SK59W |
|---|---|---|---|
| HIGHGATE | | 0.5-0.7 | 0.2-0.7 |
| SHAFTON | | 0.5-1.2 | 0.2-1.0 |
| SHARLSTON TOP | | 0.2-1.6* | 0.1-1.4 |
| SHARLSTON LOW | | 0.1-0.4 | 0.2-0.6 |
| SHARLSTON YARD: FIRST WALES | | thin-0.4 | 0-0.8 |
| HOUGHTON THIN: SECOND WALES | | ?0-0.7 | 0.3-?0.8 |
| WHEATWORTH | | ?0-1.6* | ?0-1.7* |
| SWINTON POTTERY | 0.2-0.7 | 0.2-2.1* | 0.2-0.7 |
| NEWHILL | 0.3-0.5 | 0.2-2.1* | ?0.1-0.9 |
| MELTONFIELD | 1.4-2.3* | 0.6-1.7 | ?0.5-2.1* & split |
| TWO-FOOT | 0.7-0.9 | 0.3-1.3 | 0.1-1.0 & split |
| ABDY | 0.8-1.2 | 0-1.8* | 0?-1.0 |
| TOP BEAMSHAW | ?0.3-0.5 | 0.2-1.4* | 0.6-1.4 & split |
| LOW BEAMSHAW | ?0.3-0.4 | 0.2-0.7 | thin-1.1 |
| KENT'S THIN | ?0.5-1.4 | 0.3-1.9 HH: 0.9-1.3* | 0-1.1* |
| KENT'S THICK | 0.8-?1.2 | 1.0-2.6* & split | 0.3-1.6* |
| BARNSLEY | 2.3-3.3* | 0-3.1 | 0-3.8* |
| DUNSIL | 0.6-2.1* ?& split | 0.5-2.8* & split | 0.6-2.4* & split |
| SWALLOW WOOD | 0.9-2.7* | 1.2-2.8* | 0.7-2.2 |
| TOP HAIGH MOOR | 0.3-0.6 | 0.3-4.3* & split | 1.0-1.7* |
| LOW HAIGH MOOR | ?split | 0.5-1.9* & split | thin-0.7 & split |
| LIDGET | 0.3-1.2 | 0.3-1.1 | 0.4-0.8 |
| JOAN | 0.4-0.6 | 0.3-0.8 | 0-1.0 |
| FLOCKTON THICK | 0.4 | 0.2-1.1* | 0.4-0.8 |
| | 0-3.7* | 0.1-0.9 | |
| SITWELL | 0.9 | 0.1-0.5 | |
| FLOCKTON THIN | 0.2-1.3* | 0.1-1.6* | thin?-2.2* |
| TOP FENTON | 0.1-1.9* | 0.3-1.2* | 0-2.1* & split |

| | | | |
|---|---|---|---|
| LOW FENTON | 0.6-1.9* | 0.1-1.1 | 0-0.7 |
| PARKGATE | 1.5-3.1* | 0-2.4* | 1.3-1.7 |
| THORNCLIFFE | 0.5-1.5* | 0.3-1.7*<br>thin-1.4* | 1.1-1.4 & split |
| SILKSTONE FOUR-FOOT | ?0-0.3 | thin-0.3 | |
| SILKSTONE (TOP, where split) | 0.7-2.3* | 0.7-1.2 | 0.8-1.0 |
| LOUSEY | 0.3-0.7 | ?0-0.6 | |
| BLACK BAND | 0.2-1.4* | 0.2-0.5 | |
| WHINMOOR | 0.4-1.8* | 0.5-0.8 | |

# Appendix 2 Coal Roof Characterisation

| COAL SEAM | Barnsley district | Wakefield district |
|---|---|---|
| HIGHGATE | sf | |
| SHAFTON | bs/sf | S/v |
| SHARLSTON TOP | bs/smf/sf | bsm |
| SHARLSTON LOW | S/sf | |
| SHARLSTON YARD | bsp/sf | bsp/v |
| WHEATWORTH | S/sf | v |
| SWINTON POTTERY | bs/sm(MB)/sf | v |
| NEWHILL | bs/MB | e/mb |
| MELTONFIELD | v | s/WE |
| TWO-FOOT | MB | MB |
| ABDY | bs/sm/sf/S | bsm |
| BEAMSHAW (TOP) | s/sf | s/bs |
| BEAMSHAW (LOW) | sf(HH:sf) | |
| KENT'S THIN | S/bsp | sf |
| KENT'S THICK | sf/sp/bs/bsm | s |
| WARREN HOUSE | | sp |
| LOW BARNSLEY | sp/sm | e/sp |
| DUNSIL | spf/smf | bs/v |
| SWALLOW WOOD | sf/sm | smf/v |
| (TOP) HAIGH MOOR | HMR/sf/sp | s/HMR |
| (LOW) HAIGH MOOR | sp/e | |
| LIDGET | sp/v | bsm/v |
| JOAN | MB | MB |
| FLOCKTON THICK | sm /sf | bsmf |
| SITWELL | sp | - |
| FLOCKTON THIN | bsm/sf | bsm/v |
| FENTON (TOP) | sp/sm/S | - |
| PARKGATE | v | v |
| THORNCLIFFE | sf/sm | smf |
| SILKSTONE FOUR-FOOT | sfp/bsm/S | e/S |
| BLOCKING/TOP SILKSTONE | sf/v | spf |
| LOUSEY | bs/sp | |
| BLACK BAND | spf/sm | sf |
| WHINMOOR | sf/bs/sm | - |

Abbreviations: s:mudstone (shale); b:black; f:with ironstone; m:with 'mussels'; p:with plants; v:variable; e:seatearth; MB:marine band; S:sandstone.; HH: High Hazles of Sheffield.

# Appendix 3 Shallow worked coals

The information, relating to coals worked within 30 m of the surface, is based on survey information, borehole evidence, limited mine plan coverage and opencast exploration. The coals are listed in descending order.

Note: not all opencast completion plans indicate areas of previous shallow mining.

**SE30SW**

Coals at crop: M-W

Worked coals: A, KN, B, SW, HM, L, J, FK, F, P, TN, SF, S, BD, W, (Tankersley Ironstone, Claywood Ironstone))

**SE30SE**

Coals at crop: ST-SW

Worked coals: M, TF, A, KK, B

**SE30NW**

Coals at crop: SP-F

Worked coals: M, TF, A, LBE, KK, B, Gawber and thin coal below, SW, TH, LH, J (minor-shafts), FK, F, P,(Tankersley Ironstone)

**SE30NE**

Coals at crop: HG-LBE

Worked coals: SN, ST, SL, N, M, TF, A,

**SE40NW**

Coals at crop: BY-coal above ST

Worked coal: SN

**SE40NE**

Coals at crop: Upton-Elmsall

Worked coal: ?Elmsall

**SE40SW**

Coals at crop: HG-TF

Worked coals: (fireclay above Aegiranum M. B.), SN, N rider, N, M

**SE40SE**

Coals at crop: coal above BY-WH

Worked coals: unnamed, SN, ST

**SK38NE (SHEFFIELD SHEET)***

Coals at crop: SP-MK

Worked coals: M, HH, ?KK, B and ?thin coal above, SW, P, S, MK

**SK39NW**

Coals at crop: SW-W and Pot Clay

Worked coals: J, F, P, TN and thin coal above, S, W, Pot Clay, (Tankersley Ironstone)

**SK39NE**

Coals at crop: A-W

Worked coals: KK, B and ?rider, SW, L, FK, F, P, TN, S(U), Lousey

**SK39SE (SHEFFIELD SHEET)***

Coals at crop: SP-W (SW-HH below alluvium)

Worked coals: P and coal below, TN, S, ?W, (Claywood Ironstone)

**SK48NW (SHEFFIELD SHEET)***

Coals at crop: HG-J

Worked coals: M, TF, A, HH, B, SW.

**SK49NW**

Coals at crop: SP-FK

Worked coals: N, M, TF, A, TBE, KN, KK, B, D, SW

**SK49NE**

Coals at crop: BY-TF

Worked coals: HG, SN, ST, thin coal below SP?, M, ?TF

**SK49SW (SHEFFIELD SHEET)***

Coals at crop: HG-TN (A-SP mainly below alluvium)

Worked coals: SN/HG (the latter worked at depth to the east), D, B?, SW, F(U), P, TN, (?Tankersley Ironstone)

**SK49SE (SHEFFIELD SHEET)***

Coals at crop: Brecks-SP

Worked coals: BY, HG, SN

# Appendix 4 Boreholes and shafts

Borehole and shaft data for the district are catalogued in the BGS archives (National Geosciences Records Centre) at Keyworth on individual 1:10 000 scale sheets. For further information contact: The Manager, National Geosciences Records Centre, BGS, Keyworth.

The following is a list of boreholes that have been referred to in the text, together with National Grid Reference, BGS registered number and terminal depth.

Aldewarke Main Colliery shafts [SK443 951] (SK49NW 19) 511.99 m

Barnburgh Colliery No 5 Shaft [SE4771 0320] (SE40SE 14) 708.66 m

Barnsley Main Colliery [SE3649 0603] (SE30NE 8) 591.44 m

Barrow Colliery No 3 Shaft and Staple Pit [SE3581 0261] (SE30SE 9) 503.61 m

Bentley Colliery No 2 Shaft [SE5696 0746] (SE50NE 10) 811.89 m

Bolton Dearneside [SE4618 0240] (SE40SE 64) 291.44 m

Brodsworth Colliery and No 2 Shaft deepening [SE5259 0771; 5264 0771] (SE50NW 5; 6) 782.60 m; 781.02-827.20 m

Brodsworth Colliery underground borehole No. 39 [SE5050 0793] (SE50NW 29) 91.85 m

Brodsworth Park [SE5134 0674] (SE50NW 45) 510.76 m

Brough Green [SE3360 0376] (SE30SW 18) 292.61 m

Bullcroft Main Colliery [SE5399 0969] (SE50NW 2) 626.62 m

Cadeby Main Colliery [SK5125 9952] (SK59NW 5) 689.00 m

Cherry Tree [SE4915 1173] (SE41SE 9) 593.75 m

Common Quarry No. 2 [SE5281 0645] (SE50NW 46) 509.00 m

Conisbrough Grange [SK5061 9413] (SK59SW 76) 1010.52 m

Conisbrough Parks Farm [SK5062 9716] (SK59NW 23) 300.23 m

Cortonwood Colliery c[SE4067 0143] (SE40SW 22) 525.59 m

Cusworth [SE5417 0404] (SE50SW 2) 258.78 m

Darton Main Colliery No 1 Shaft [SE3065 1015] (SE31SW 26A) 191.17 m

Denaby Main Colliery [SK494 999] (SK49NE 11) 733.81 m

Derry Grove [SE4520 0518] (SE40NE 56) 393.18 m

Elmsall Lane [SE4813 0906] (SE40NE 66) 609.44 m

Elsecar Main Colliery [SE3902 0028] (SE30SE 12) 488.37 m

Frickley Colliery [SE4680 0962] (SE40NE 17) 630.61 m

Frickley Colliery underground borehole No. 38 [SE4717 0918] (SE40NE 62) 231.65 m

Green Lane [SE5426 0619] (SE50NW 3) 271.37 m

Grimethorpe Colliery c[SE4085 0840] (SE40NW 9) 541.43 m

Hermit Hill, Wortley [SE3179 0084] (SE30SW 6) 96.32 m

Hickleton Colliery underground borehole No. 11 [SE4834 0742] (SE40NE 32) 47.30 m

Hickleton Colliery underground borehole Nos. 13 and 13A [SE 4969 0718] (SE40NE 22) 47.42 m

Highfield Lane [SE4232 1239] (SE41SW 3) 984.20 m

Houghton Main Colliery No 2 Shaft [SE4191 0602] (SE40NW 10) 728.35 m

Kilnhurst Colliery No 4 Shaft [SK4617 9682] (SK49NE 4) 618.74 m

Listerdale [SK4624 9160] (SK49SE 39) 690.29 m

Manvers Main Colliery No 4 Shaft [SE4534 0067] (SE40SE 16) 608.08 m

Markham Main Colliery No 1 Shaft [SE6168 0453] (SE60SW 15) 846.16 m

Marsh Hill [SK5190 9426] (SK59SW 77) 1029.94 m

Moor Lane [SE4311 0745] (SE40NW 136) 186.23 m

Nearcliff Quarry [SK5270 9938] (SK59NW 45) 1091.69 m

Nunnery (Handsworth) Colliery [SK4092 8688] (SK48NW 75) 374.19 m

Old Silkstone Colliery, Dodworth [SE3118 0565] (SE30NW 14) 238.35 m

Park Mill Colliery underground borehole No.11 [SE2828 1079] (SE21SE 59) 89.00 m

Park Mill Colliery underground borehole No.16 [SE2702 1255] (SE21SE 58) 88.04 m

Peak Lane [SK5250 9105] (SK59SW 81) 981.92 m

Pinch Mill [SK4656 9050] (SK49SE 40) 538.71 m

Ravenfield Grange [SK4928 9459] (SK49SE 44) 1013.88 m

Redbrook Colliery [SE3288 0792] (SE30NW 12) 490.11 m

Rockingham Colliery [SE3527 0110] (SE30SE 13) 324.86 m

Royd Moor No 1 [SE4472 1381] (SE41SW 1) 93.73 m

Ruddle Lane [SK5213 9532] (SK59NW 24) 1058.32 m

St Helen’s No 2 [SE4951 0325] (SE40SE 54) 596.82 m

Sandy Flat [SK4767 9095] (SK49SE 46) 898.43 m

Shaftholme Grange [SE5764 0877] (SE50NE 33) 504.65 m

Shortwood Lane [SE4430 0764] (SE40NW 123) 508.52 m

Sidcop Road [SE3850 0996] (SE30NE 72) 714.60 m

Silkstone Fall Colliery [SE3017 0528] (SE30NW 58) 77.11 m

Silverwood Colliery [SK4786 9395] (SK49SE 11) 681.23 m

Spa Hill No 2 [SK4389 8786] (SK48NW 23) 121.92 m

Spital Croft [SK5757 9493] (SK59SE 26) 1107.18 m

Strafford Colliery [SE3216 0412] (SE30SW 5) 319.43 m

Sun Inn [SE5536 0492] (SE50SE 21) 249.94 m

Tankersley Colliery [SK3415 9896] (SK39NW 3) 221.78 m

Thorpe Hesley Colliery [SK3818 9632] (SK39NE 10) 246.86 m

Thurcroft Main Colliery [SK4992 8967] (SK48NE 27) 680.81 m

Treeton Colliery [SK4367 8782] (SK48NW 4) 384.38 m

Upton Colliery West (No 2) Shaft [SE4819 1334] (SE41SE 27) c650 m (incomplete record)

Wharncliffe Silkstone Colliery [SK3390 9990] (SK39NW 2a) 199.42 m

Wharncliffe Woodmoor Colliery No 3 underground borehole [SE3526 0886] (SE30NW 18) 166.12 m

Wilsic Hall [SK5676 9601] (SK59NE 32) 1122.55 m

Womersley No 2 [SE5362 1864] (SE51NW 34) 766.43 m

Woodside [SE5059 0363] (SE50SW 45) 775.64 m

Yorkshire Main Colliery [SK5440 9916] (SK59NW 4) 833.02 m

# References

Most of the references listed below are held in the Library of the British Geological Survey at Keyworth, Nottingham. Copies of the references may be purchased from the Library subject to the current copyright legislation.

A Aitken, J F, Quirk, D G, and Guion, P D. 1999. Regional correlation of Westphalian sandbodies onshore UK: implications for reservoirs in the Southern North Sea. 747-756 in *Petroleum Geology of Northwest Europe: Proceedings of the 5th Conference*. Fleet, A J, and Boldy, S A R (editors). (London: Geological Society.)

Bedrock, M. 1984. *Sedimentology of some Westphalian C sequences in the Yorkshire Coalfield*. Unpublished PhD thesis, Royal School of Mines, University of London.

Besly, B M, and Fielding, C R. 1989. Palaeosols in Westphalian coal-bearing and red-bed sequences, central and northern England. *Palaeogeography, Palaeoclimatology, Palaeoecology*, Vol. 70, 303-330.

Cochrane, S T. 1991. *Aspects of the geology of the Barnsley Seam in the northern part of the Yorkshire Coalfield*. Unpublished manuscript of a paper given at the Geological Society Coal Geology Group Meeting, Sheffield 1991.

Culpin, H. 1909. Marine, and other, fossils in the Yorkshire Coal Measures above the Barnsley Seam. *Proceedings of the Yorkshire Geological Society*, Vol. 16, 321-334.

Deans, T. 1936. Some oolitic ironstones from the Coal Measures of Yorkshire. *Transactions of the Leeds Geological Association*, Vol. 5, 161-187.

Eden, R A, Elliott, R W, Elliott, R E, and Young, B R. 1963. Tonstein bands in the coalfields of the East Midlands. *Geological Magazine*, Vol. 100, 47-58.

Eden, R A, Stevenson, I P, and Edwards, W. 1957. The geology of the country around Sheffield. *Memoir of the Geological Survey of Great Britain*, Sheet 100.

Edwards, W, Wray, D A, and Mitchell, G H. 1940. Geology of the country around Wakefield. *Memoir of the Geological Survey of Great Britain*, Sheet 78.

Gaunt, G D. 1994. Geology of the country around Goole, Doncaster and the Isle of Axholme. *Memoir of the British Geological Survey*, sheets 79 and 88 (England and Wales).

Green, A H, Russell, R, Dakyns, J R, Ward, J C, Fox Strangways, C, Dalton, W H, and Holmes, T V. 1878. The geology of the Yorkshire Coalfield. *Memoir of the Geological Survey of Great Britain*.

Guion, P D, Banks, N L, and Rippon, J H. 1995. The Silkstone Rock (Westphalian A) from the east Pennines, England: implications for sand body genesis. *Journal of the Geological Society of London*, Vol.152, 819-832.

Guion, P D, and Fielding, C R. 1988. Westphalian A and B sedimentation in the Pennine Basin, UK. 153-177 in *Sedimentation in a synorogenic basin complex: the Upper Carboniferous of north-west Europe*. Besly, B M, and Kelling, G. (editors). (Blackie: Glasgow and London).

Hough, E, Lake, R D and Hobbs, P R N. In Prep. Geology of the Barnsley district- a brief explanation of the geological map. *Sheet Explanation of the British Geological Survey*. 1:50 000 Sheet 87 Barnsley (England and Wales).

Lake, R D. 1999. The Wakefield district-a concise account of the geology. *Memoir of the British Geological Survey*, Sheet 78.

Mitchell, G H, Stephens, J V, Bromehead, C E N, and Wray, D A. 1947, reprinted 1954. The geology of the country around Barnsley. *Memoir of the Geological Survey of Great Britain*.

Price, N B, and Duff, P McL D. 1969. Mineralogy and chemistry of tonsteins from Carboniferous sequences in Great Britain. *Sedimentology*, Vol.13, 45-69.

Scott, A C. 1978. Sedimentological and ecological control of Westphalian B plant assemblages from West Yorkshire. *Proceedings of the Yorkshire Geological Society*, Vol.41, 461-508.

Spears, D A, and Kanaris-Sotiriou, R. 1979. A geochemical and mineralogical investigation of some British and other European tonsteins. *Sedimentology*, Vol. 26, 407-425.

Stubblefield, C J, and Trotter, F M. 1957. Divisions of the Coal Measures on Geological Survey maps of England and Wales. *Bulletin of the Geological Survey of Great Britain*, No 13, 1-5.

Wilcockson, M A, and Goossens, R F. 1957. Geological research in the Yorkshire Coalfield over the past one hundred years. *Transactions of the Institute of Mining Engineers*, Vol. 117, 622-641.

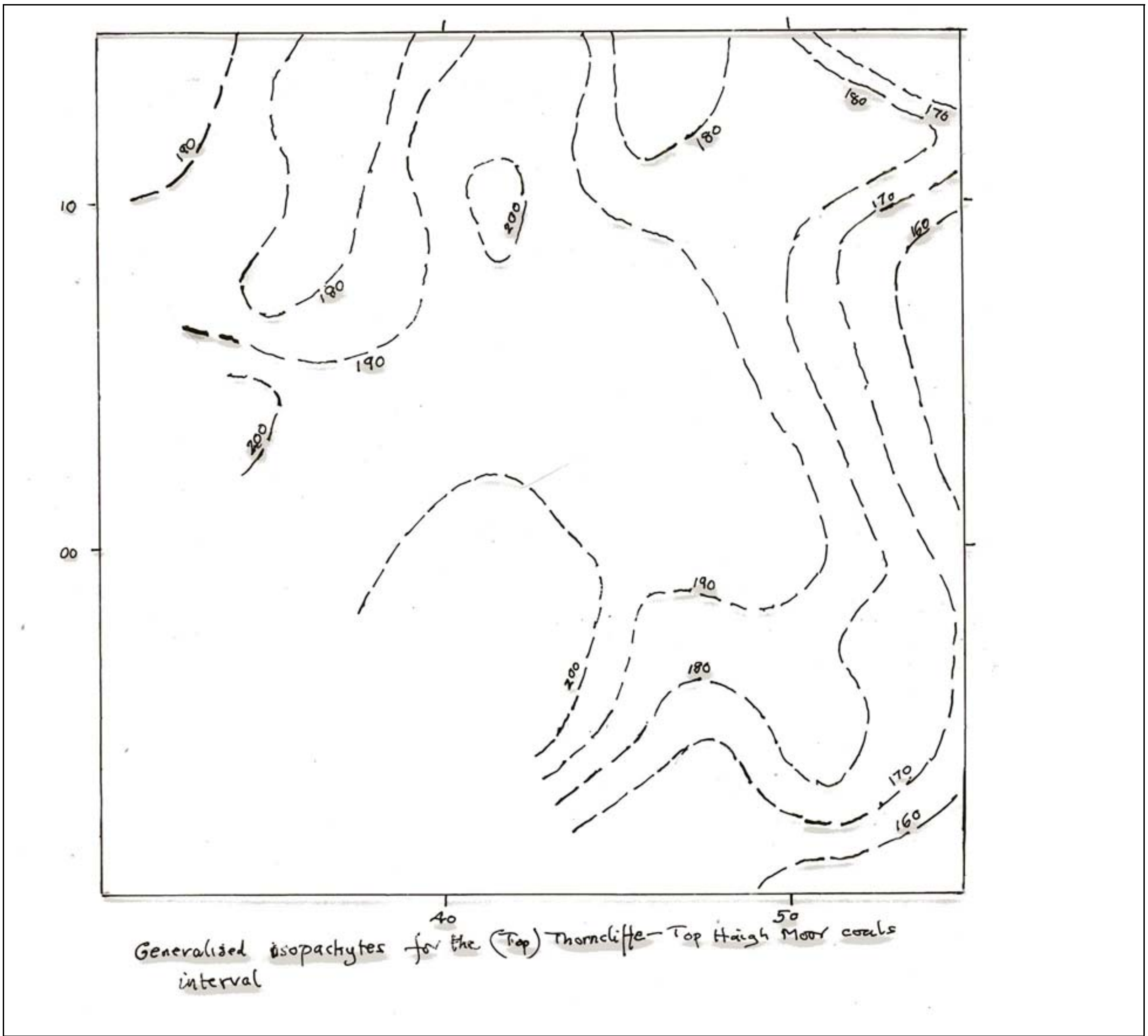


**Figure 1. Generalized isopachytes for the (Top) Thorncliffe-Top Haigh Moor coals interval**

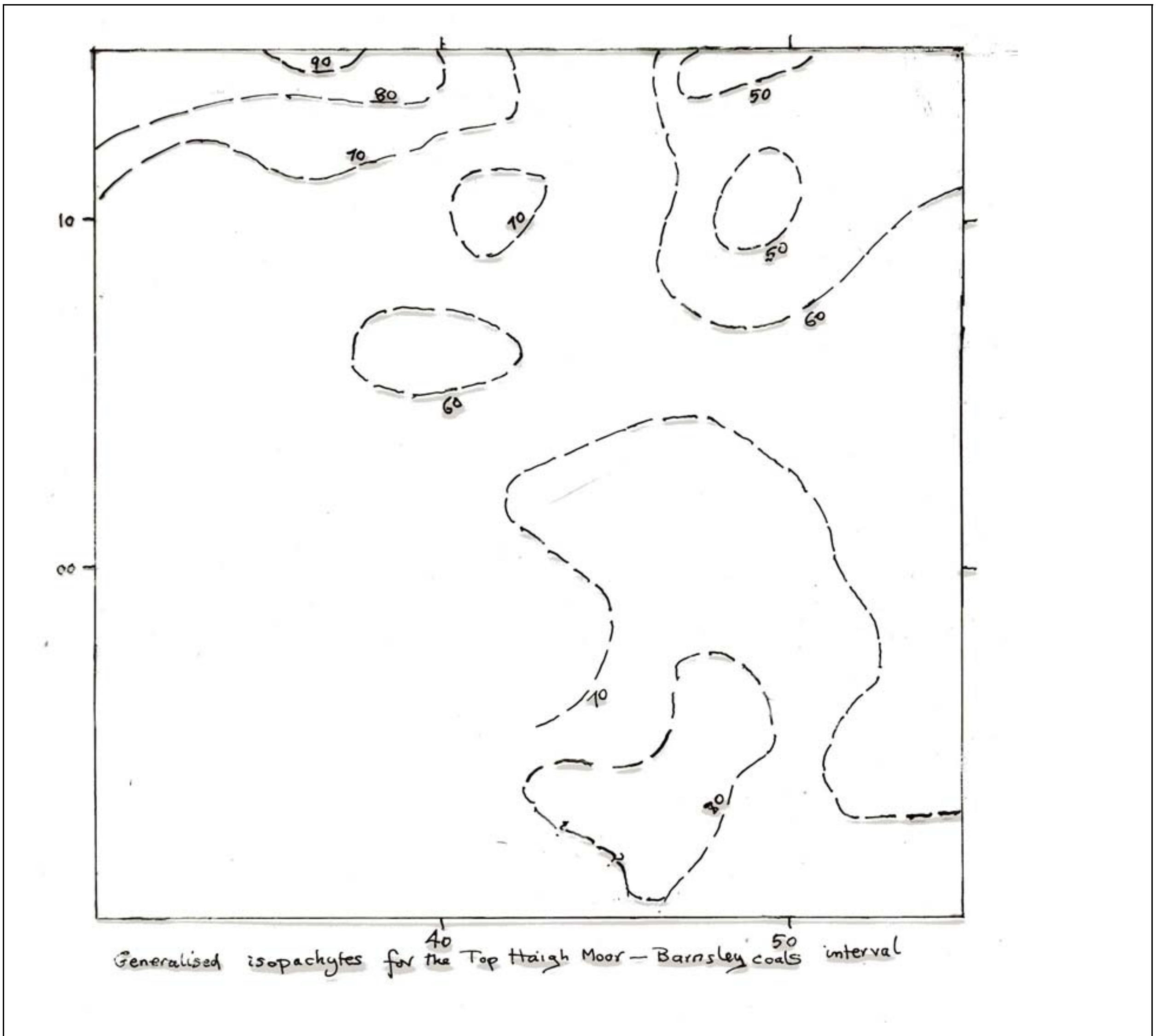


**Figure 2. Generalized isopachytes for the Top Haigh Moor-Barnsley coals interval**

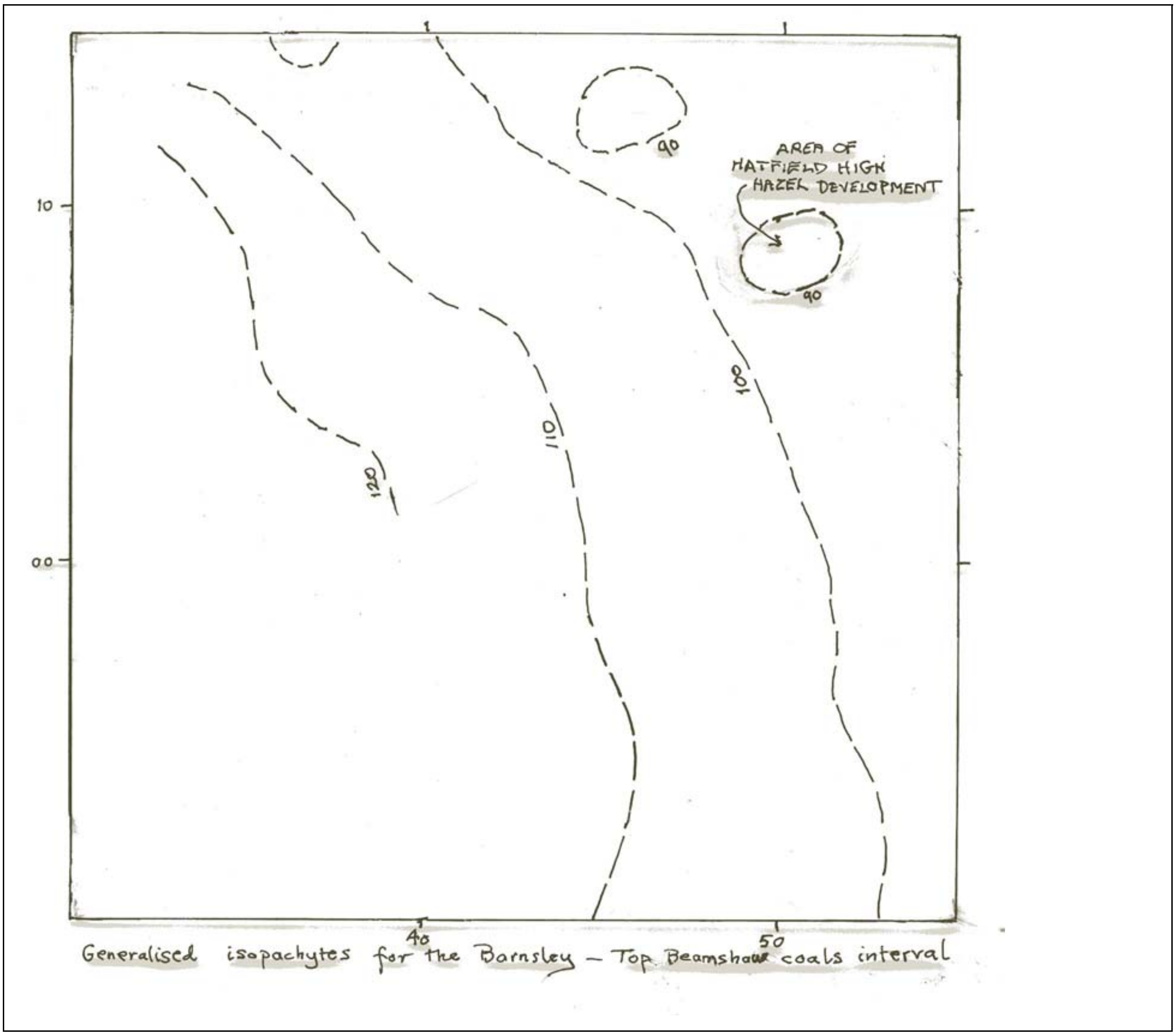


**Figure 3. Generalized isopachytes for the Barnsley-Top Beamshaw coals interval**

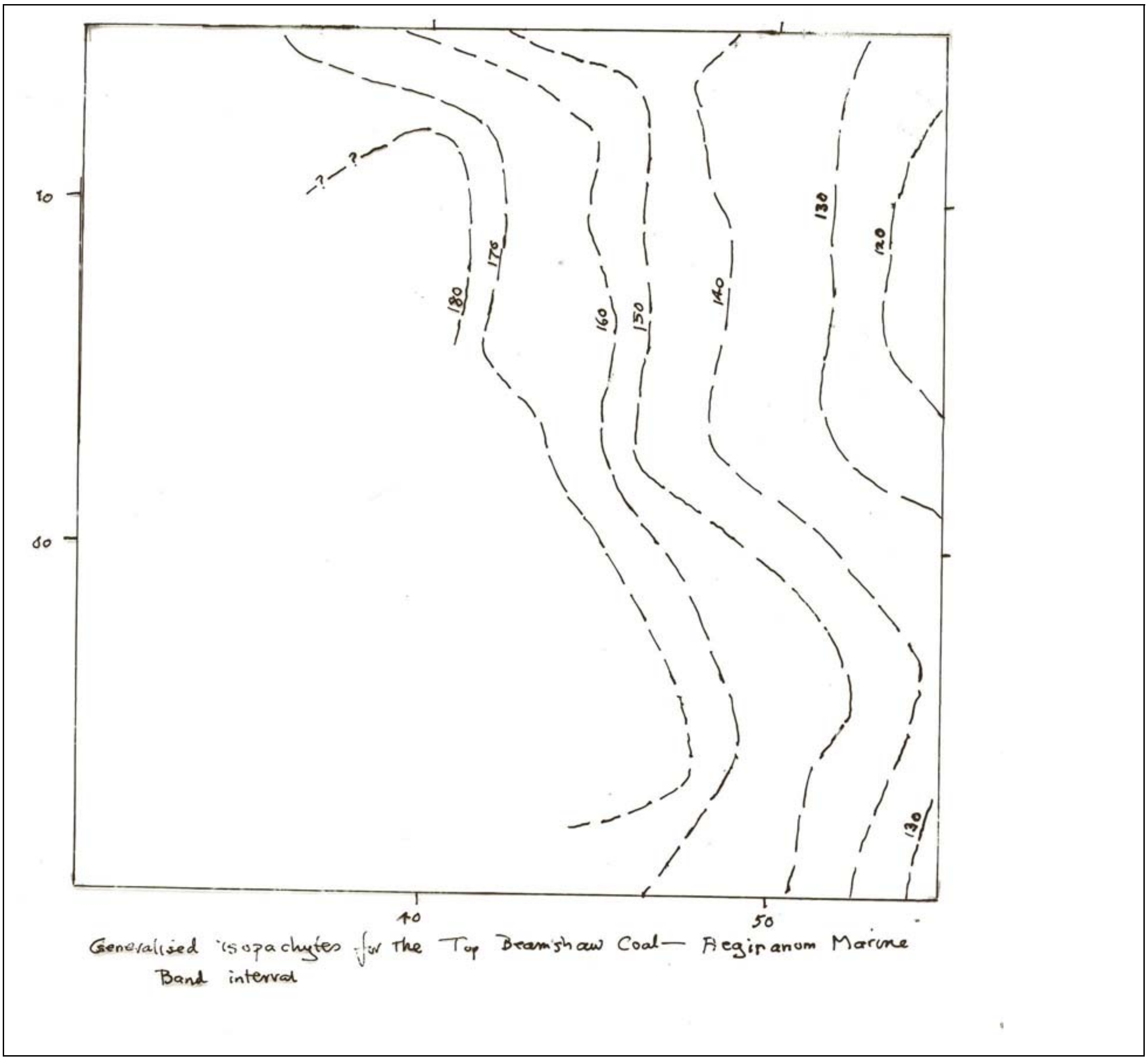


**Figure 4. Generalized isopachytes for the Top Beamshaw Coal-Aegiranum Marine Band interval**

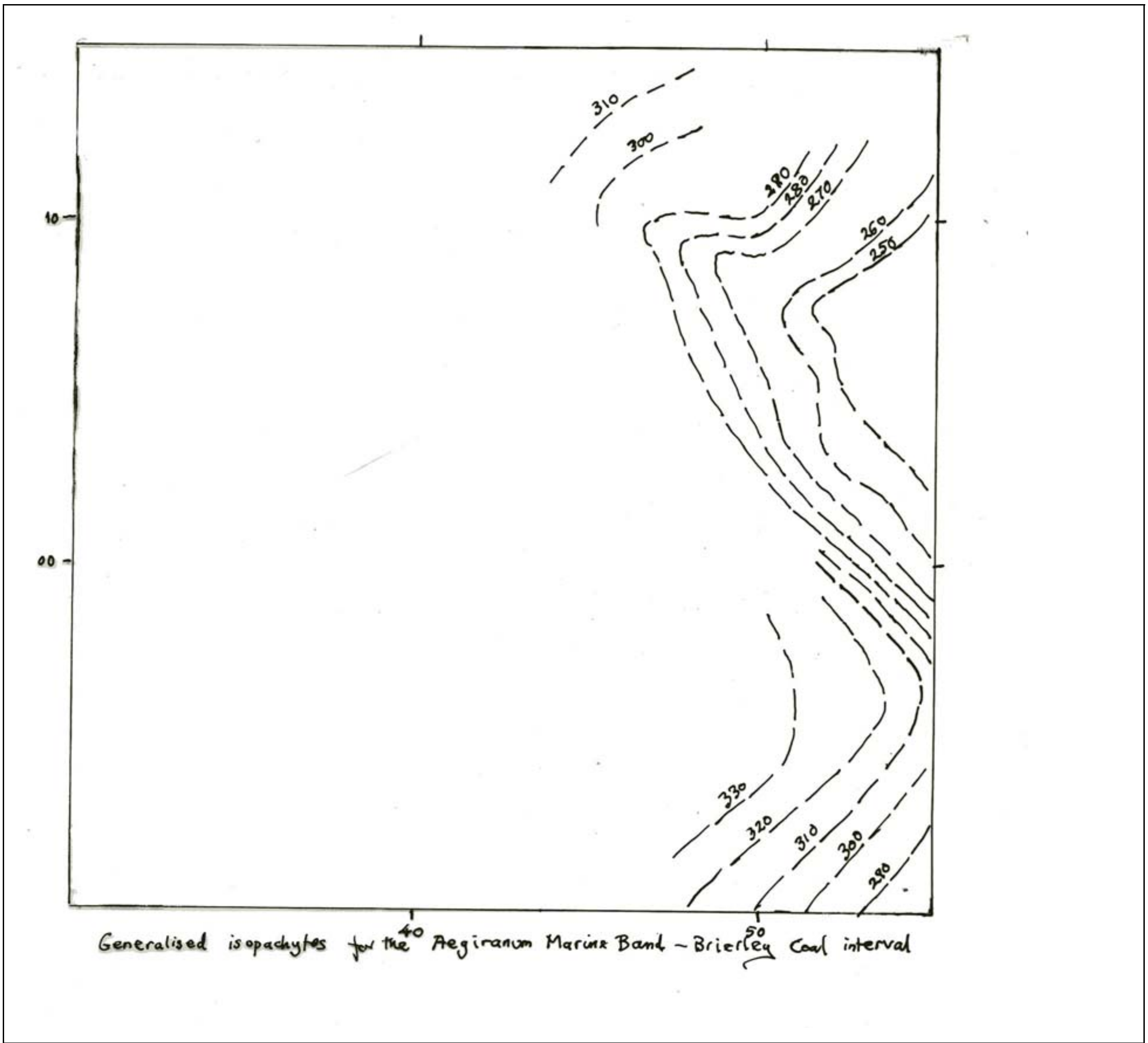


**Figure 5. Generalized isopachytes for the Aegiranum Marine Band-Brierley Coal interval**

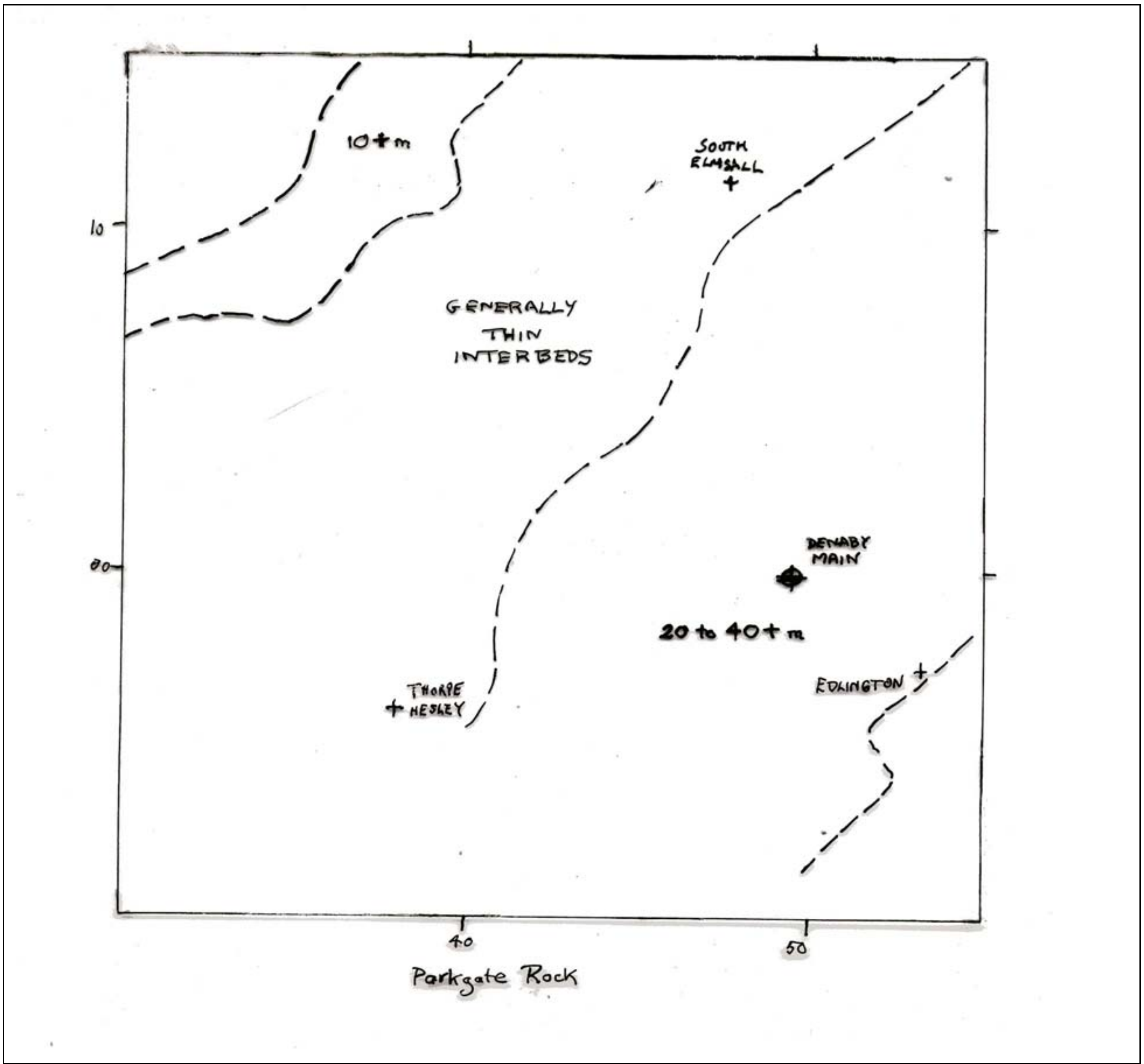


**Figure 6. Generalized distribution and thickness of the Parkgate Rock**

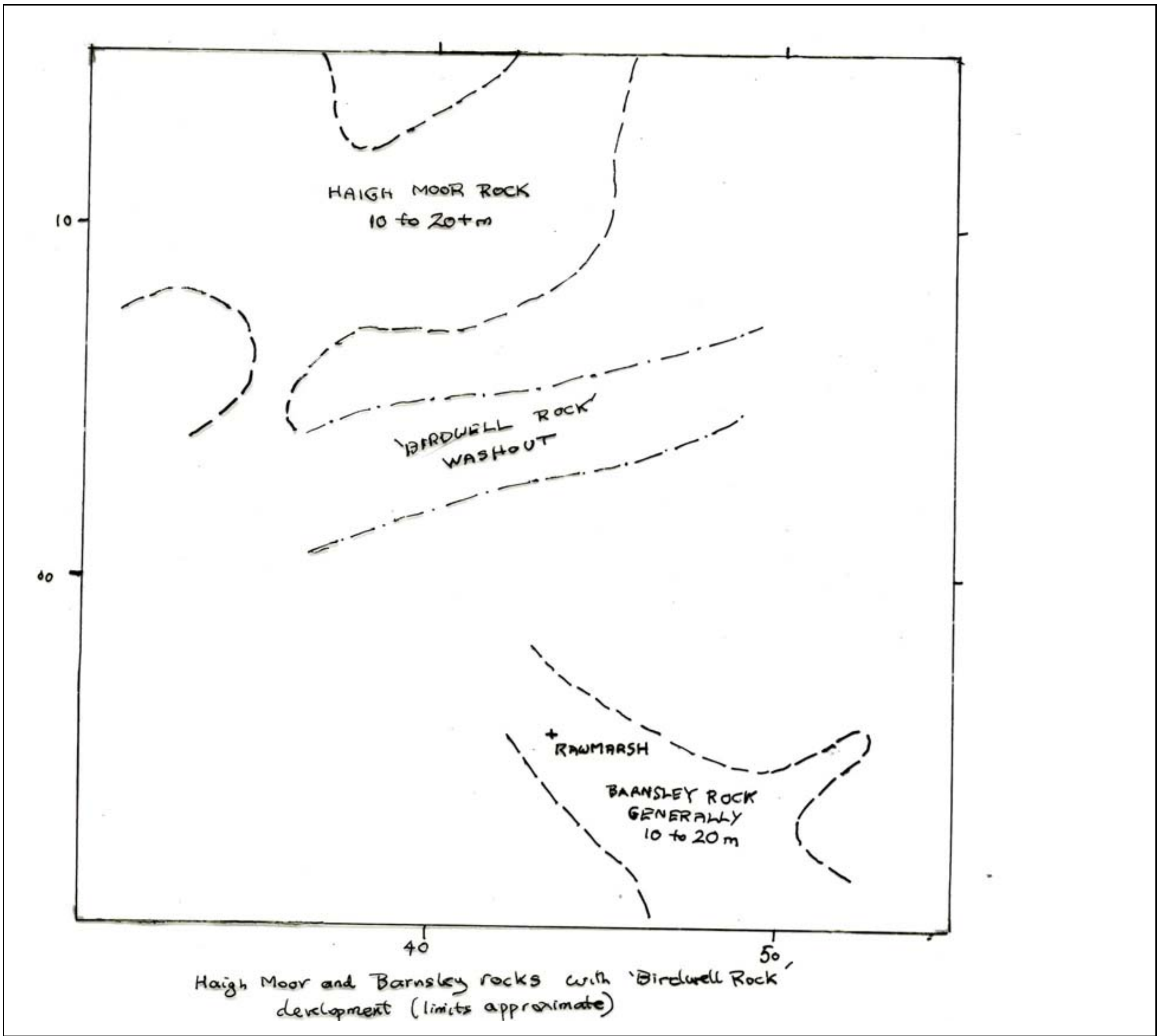


**Figure 7. Generalized distribution and thickness of the Haigh Moor and Barnsley rocks with 'Birdwell Rock' development (limits approximate)**

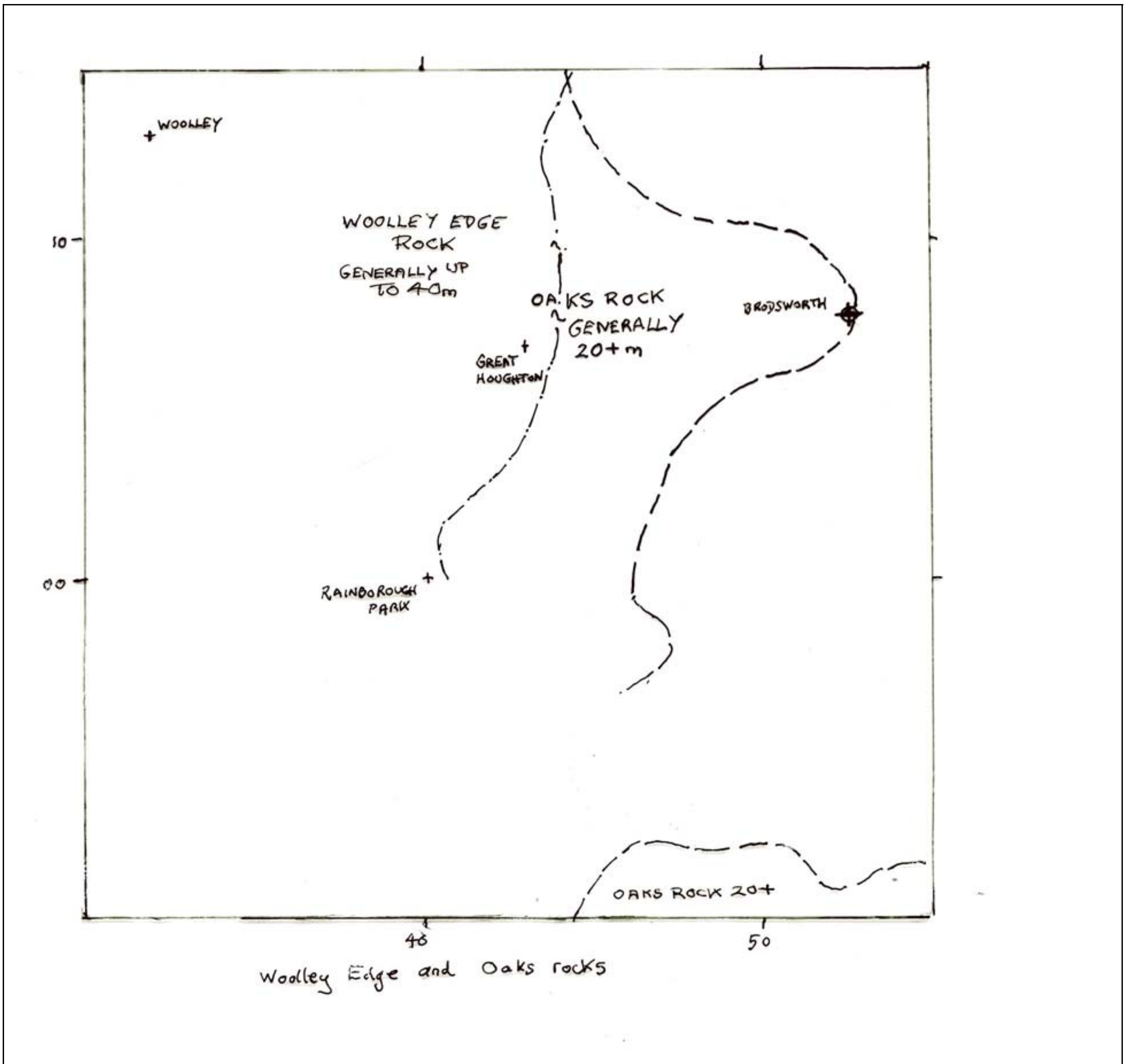


**Figure 8. Generalised distribution and thickness of the Woolley Edge and Oaks rocks**

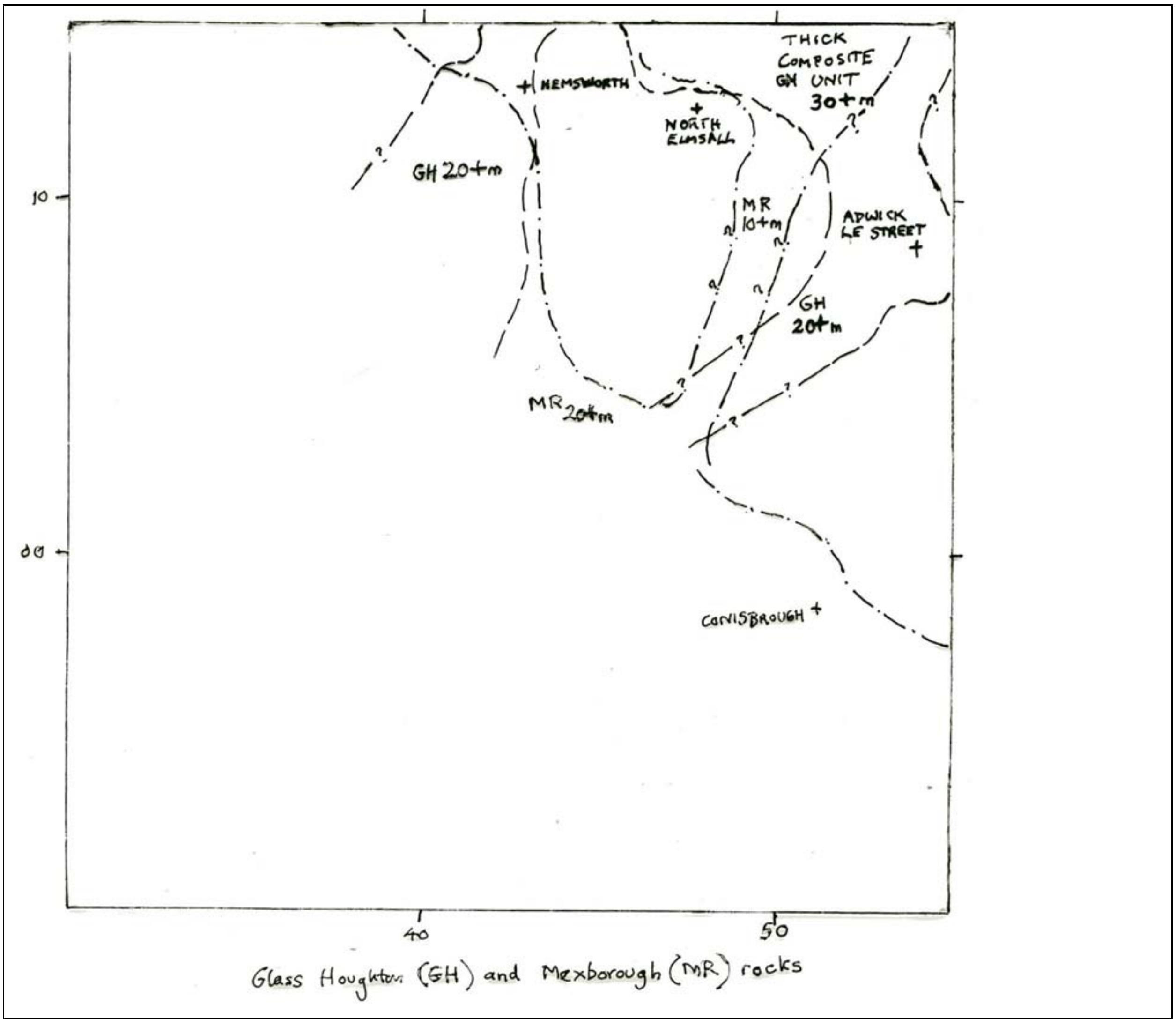


**Figure 9. Generalised distribution and thickness of the Glass Houghton (GH) and Mexborough (MR) rocks**

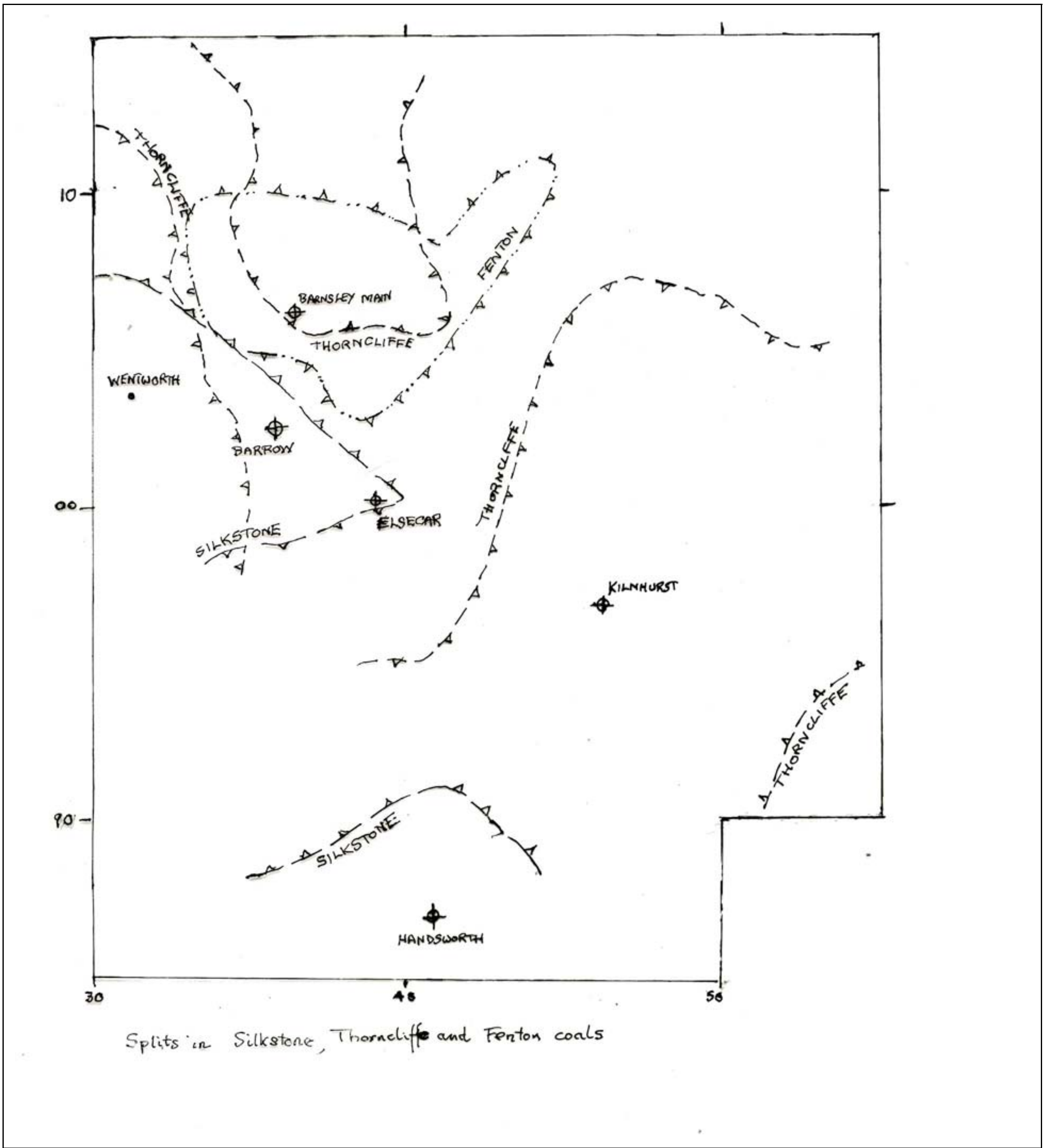


**Figure 10. Splits in the Silkstone, Thorncliffe and Fenton coals**

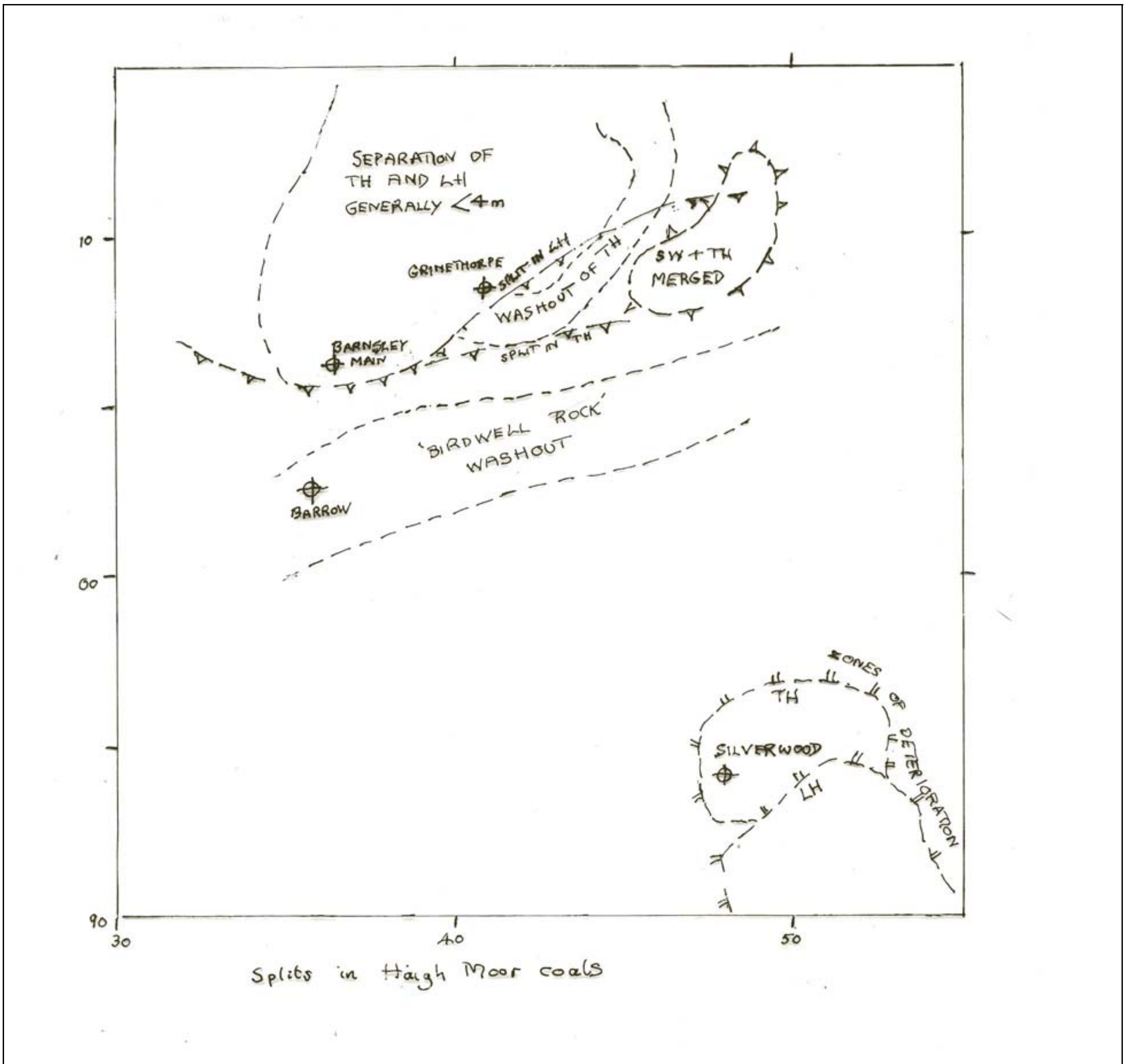


**Figure 11. Splits in Haigh Moor coals**

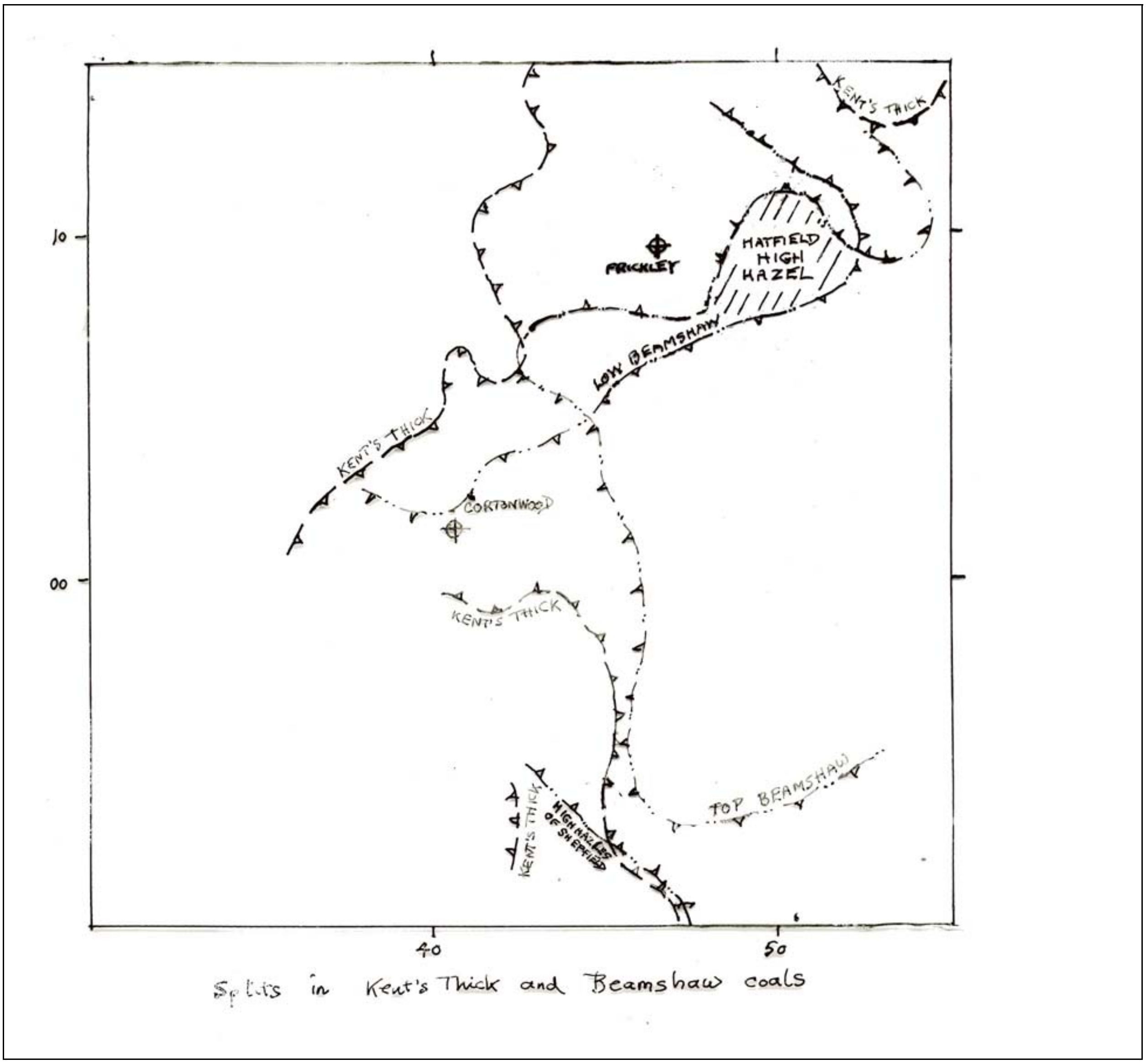


**Figure 12. Splits in Kent's Thick and Beamshaw coals**

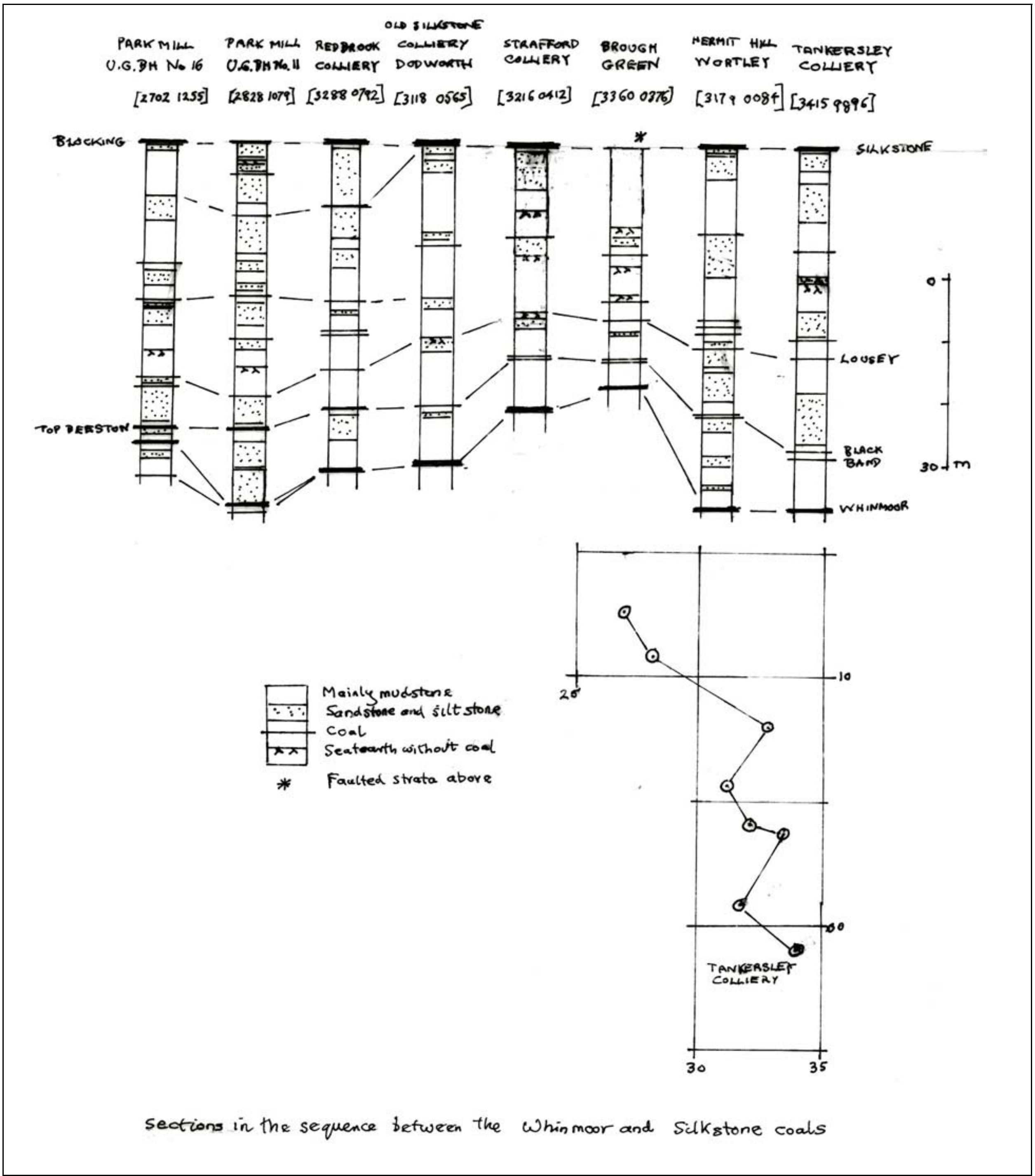


Figure 13. Sections in the sequence between the Whinmoor and Silkstone coals

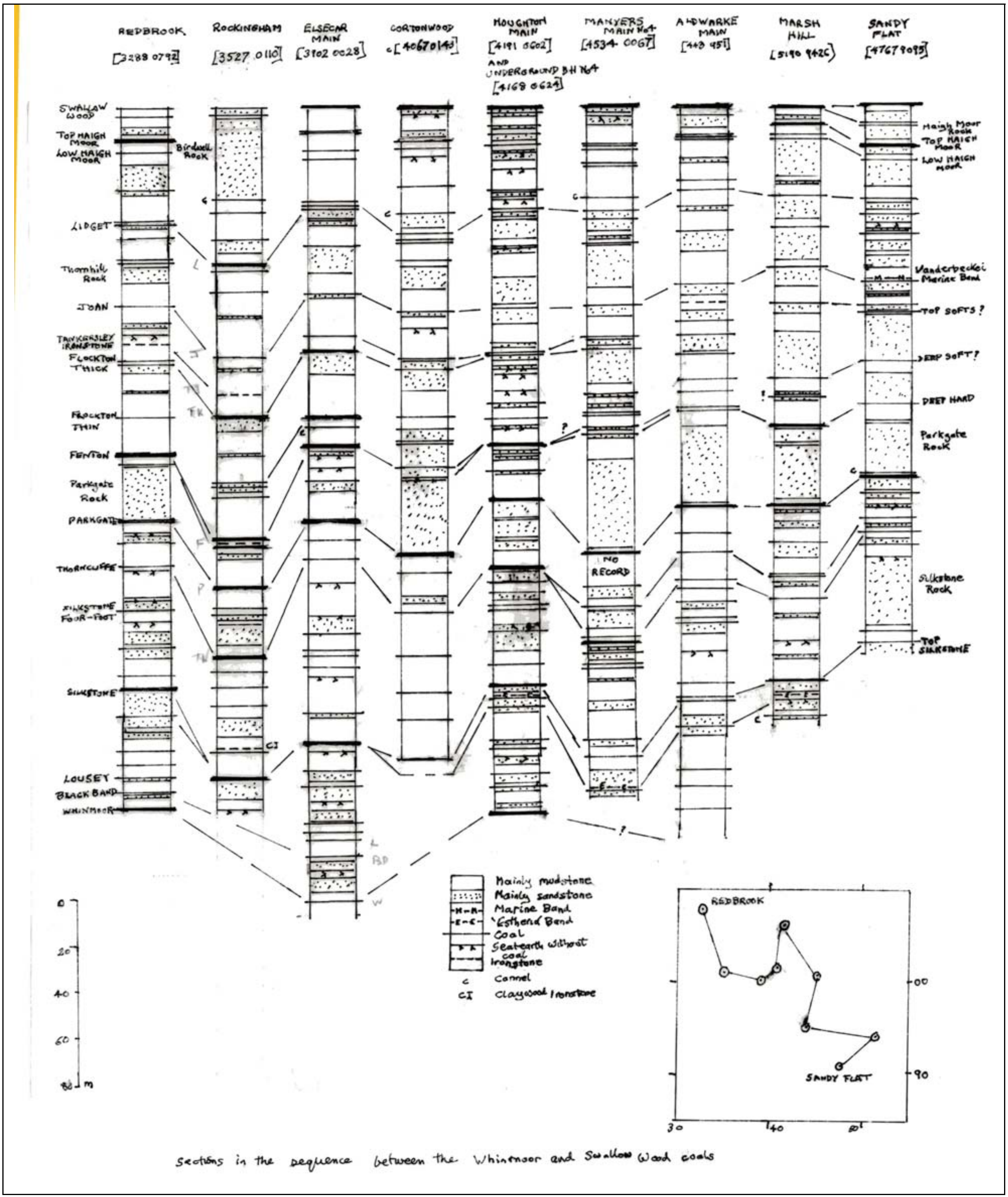


**Figure 14. Sections in the sequence between the Whinmoor and Swallow Wood Coals**

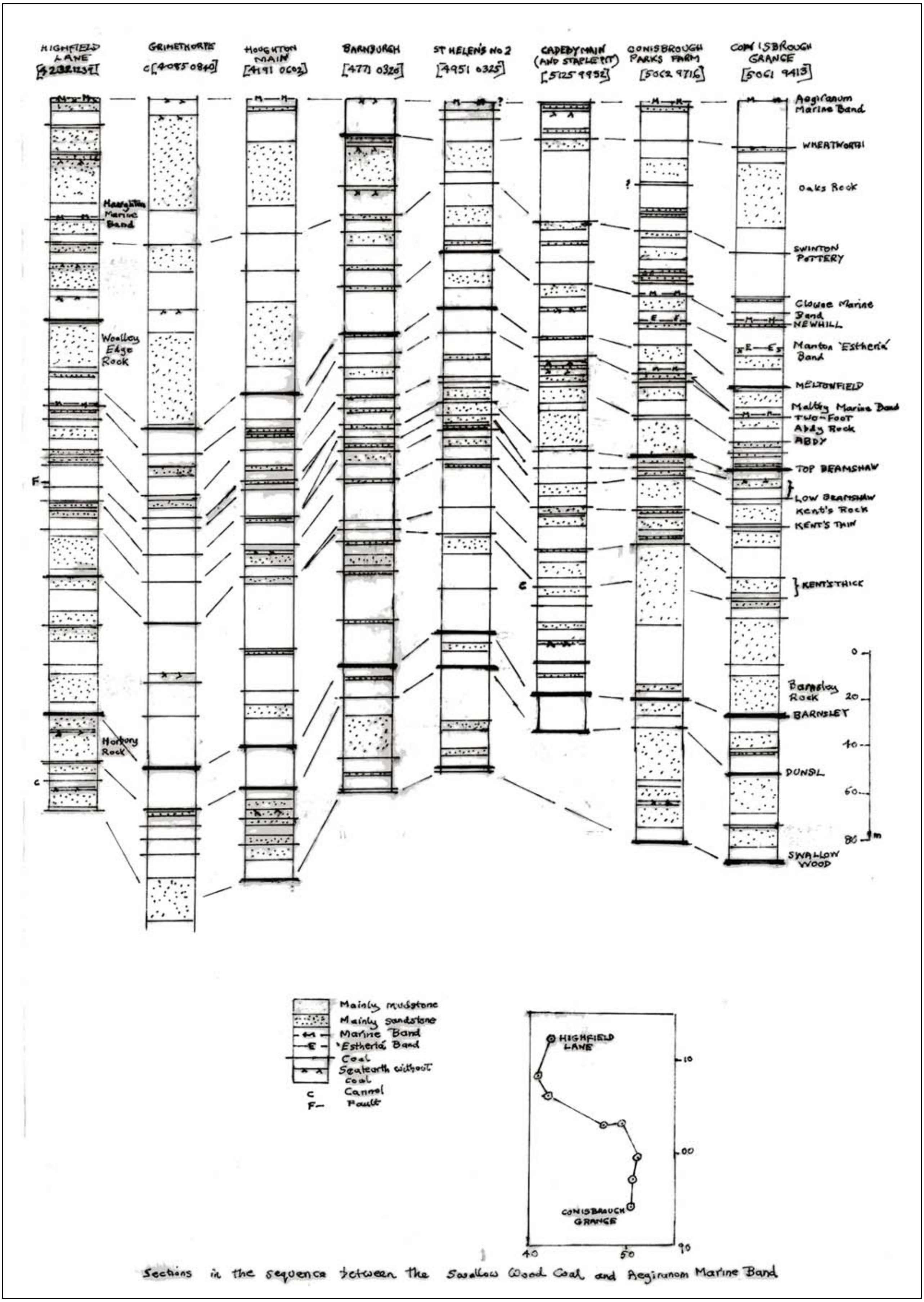


**Figure 15. Sections in the sequence between the Swallow Wood Coal and Aegiranum Marine Band**

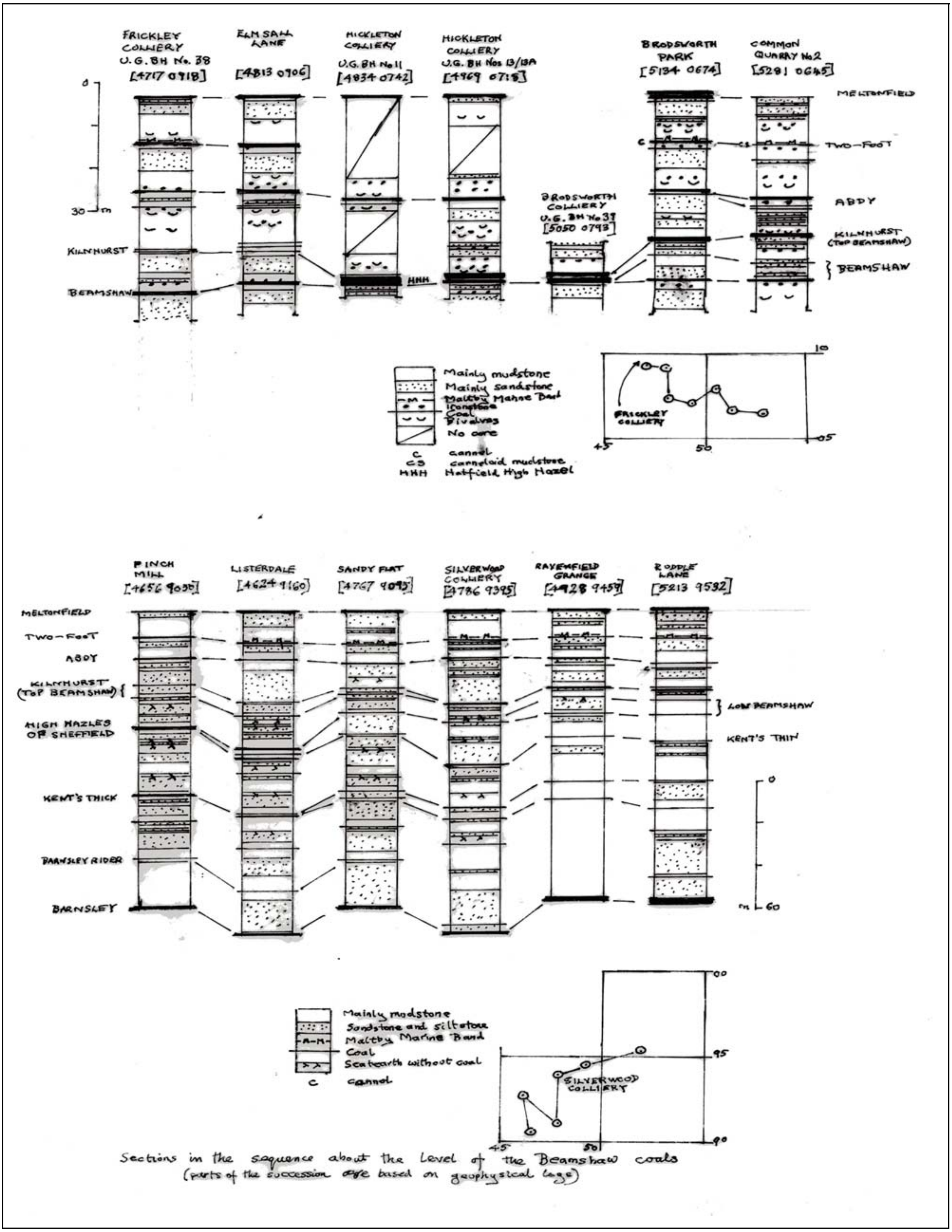

Figure 16a (above): Sections in the sequence about the level of the Bramshaw coals (parts of the succession are based on geophysical logs) (northern part of district).

Figure 16b (below): Sections in the sequence about the level of the Bramshaw coals (parts of the succession are based on geophysical logs) (southern part of district).

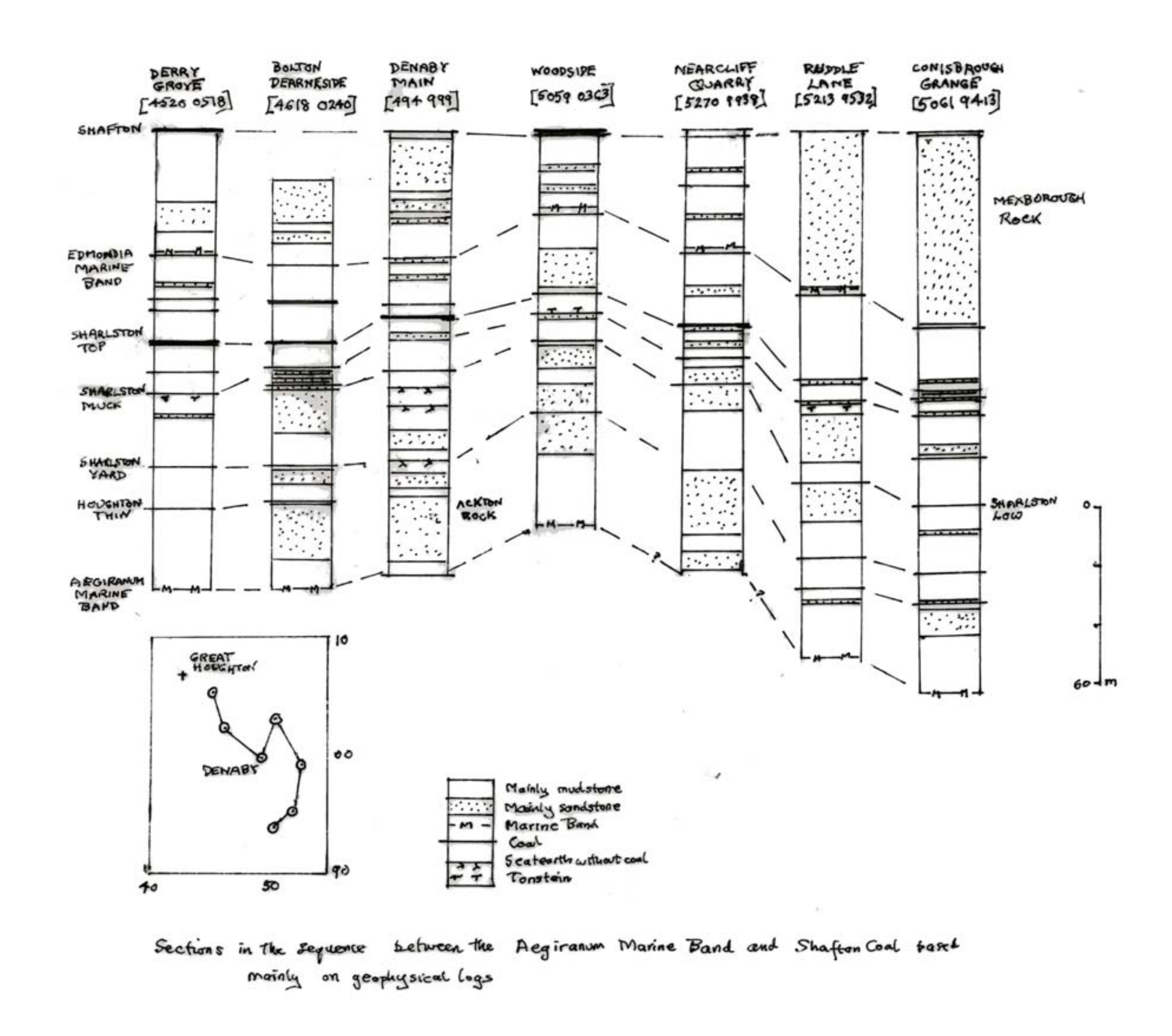


**Figure 17. Sections in the sequence between the Aegiranum Marine Band and Shafton Coal based mainly on geophysical logs**

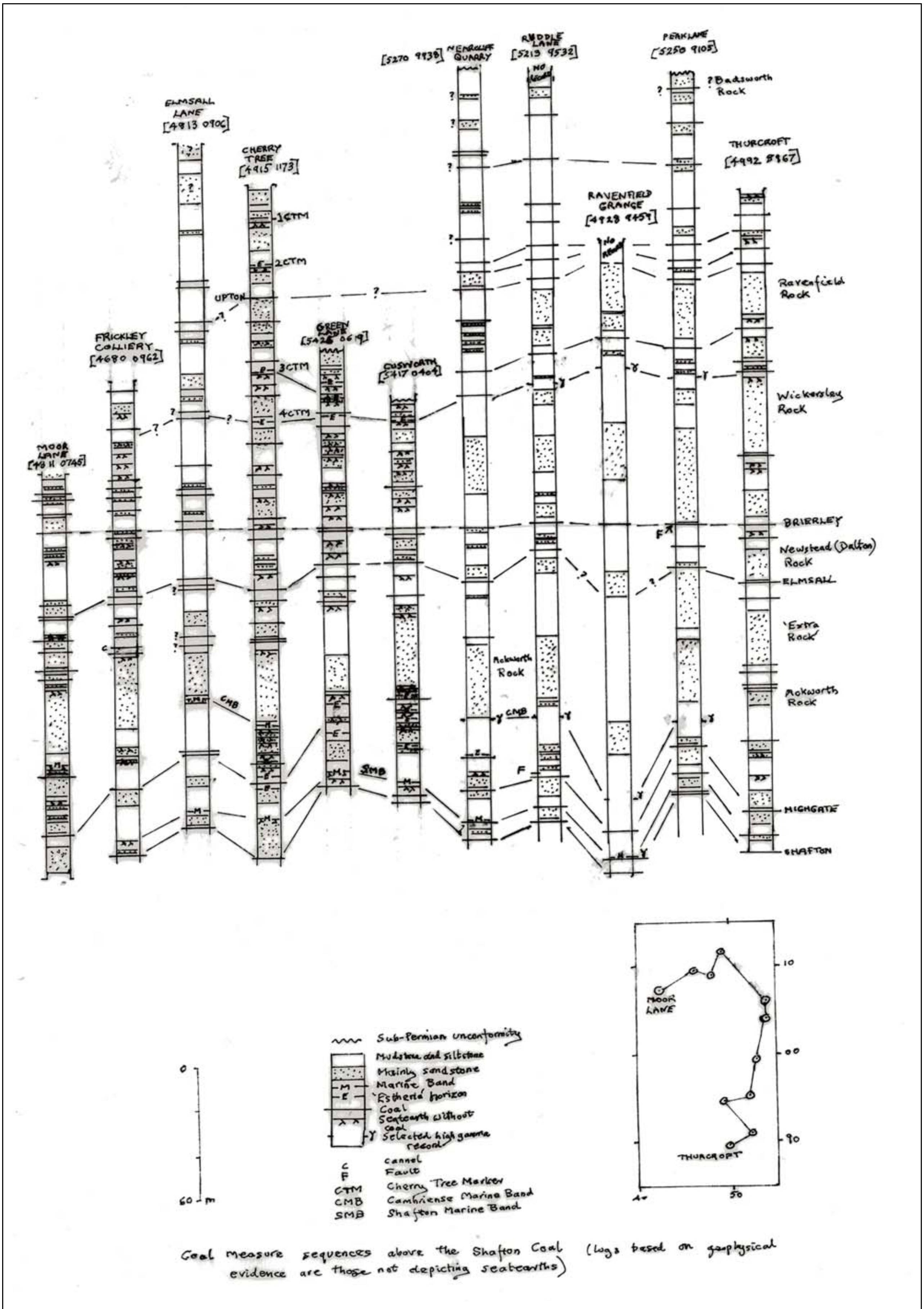


**Figure 18. Coal Measures sequences above the Shafton Coal (logs based on geophysical evidence are those not depicting seatearths**