Natural Environment Research Council

British Geological Survey

Onshore Geology Series

TECHNICAL REPORT WA/96/80

Geology of the Sherrifhales area

1:10 000 sheet SJ 71 SE and part of SJ 71 NE
Part of 1:50 000 sheet 153 (Wolverhampton)

E HOUGH

Geographical index
East Shropshire, Sherrifhales

Subject index
Geology, Productive Measure, Barren Measures,
Permian, Triassic, Quaternary

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CONTENTS

FIGURES

1. INTRODUCTION

This report describes the geology of 1:10 000 sheet SJ 71 SE (Sheriffhales) and the southern part of SJ 71 NE (Newport East), south of northing $^{3}17$ (Figure 1). This area was first surveyed geologically at the 1:10 560 scale by E E L Dixon and T H Whitehead between 1919 and 1924 and published on County Sheets Staffordshire 43SW, 49NW, and Shropshire 31SW, 37NW, 37SW and 37SE. The one-inch Geological Sheet 153 (Wolverhampton), which includes both areas, was published in 1929, and the accompanying sheet memoir (Whitehead *et al.*) dates from 1928. A 1 km strip at the western margin of the area ($^{3}10$ - $^{3}16$) was surveyed by R J O Hamblin in 1970 - 72 as overlap for the Telford Special Sheet; the remainder was surveyed by E Hough in 1996. This report deals primarily with the latter area, although reference is made to boreholes in ground surveyed by R J O Hamblin.

The district, which lies astride the Shropshire-Staffordshire county boundary, is rural, with arable farming the main industry. At the time of survey, there were no active mineral workings in the district. However, sand and gravel was extracted from small-scale workings at the Burlington Gravel Pit, until operations ceased in 1980, and quarrying of sandstone at Woodcote Hill was carried out during the last century.

The watershed in the west of the district forms high ground reaching 140 m above OD. Eastwards, the ground falls towards a broad, north-west-trending valley containing the tributaries of Back Brook (including Dawford Brook and Moreton Brook). The A5 and A41 trunk roads cross the district in east-west and north-south directions, respectively.

The district is underlain by Upper Carboniferous to Triassic rocks, which dip eastwards and rest on a basement of probable Precambrian age (Hamblin and Coppack, 1995). The succession above and including the Permian Bridgnorth Sandstone Formation forms part of the western margin of the South Staffordshire Basin, which has its depocentre to the north-east of the sheet area.

Patchy till covers much of the district, becoming more prevalent to the east. A cover of sandy till (up to 3 m thick) rests on the dip slope of the Kidderminster Formation. Well-featured mounds of Glaciofluvial Sand and Gravel, forming part of the 'Newport Esker Chain' (Whitehead *et al.*), trend south-south-eastwards across the east of the district.

All National Grid references in this report lie within 100 km grid square SJ, and are given as eight figure numbers within square brackets.

A report covering contiguous 1:10 000 sheets SJ 70 NW and SJ 81 SW is in preparation.

The area to the west is described in the Sheet Memoir 'Telford and the Coalbrookdale Coalfield', (Hamblin and Coppack), published in 1995.

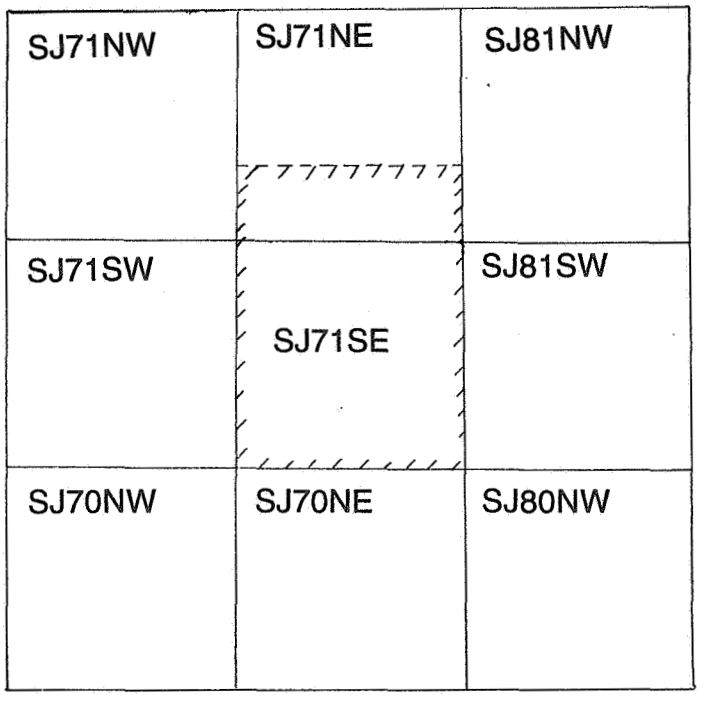

Figure 1: Location map showing district surveyed and adjoining 1:10 000 National Grid Sheets.

district surveyed

2. GEOLOGICAL SEQUENCE

QUATERNARY (not necessarily in order of superposition)

- Peat
- Alluvium
- Glaciofluvial Sand and Gravel
- Glaciolacustrine Deposits
- Sandy Till and Till

TRIASSIC

- Sherwood Sandstone Group
  - Bromsgrove Sandstone Formation
  - Wildmoor Sandstone Formation
  - Kidderminster Formation

PERMIAN

- Bridgnorth Sandstone Formation

CARBONIFEROUS

- Barren Measures
  - Salop Formation
    - Enville Member
    - Alveley Member
  - Halesowen Formation
  - Etruria Formation
- Productive Measures
  - Middle Coal Measures
  - Lower Coal Measures

? PRECAMBRIAN BASEMENT

Nine NCB coal exploration boreholes, drilled in the district between 1940 and 1977 (Figure 2), provide information on the pre-Mesozoic succession. Of these, only Lilleshall No. 5 proved rocks older than the Lower Coal Measures.

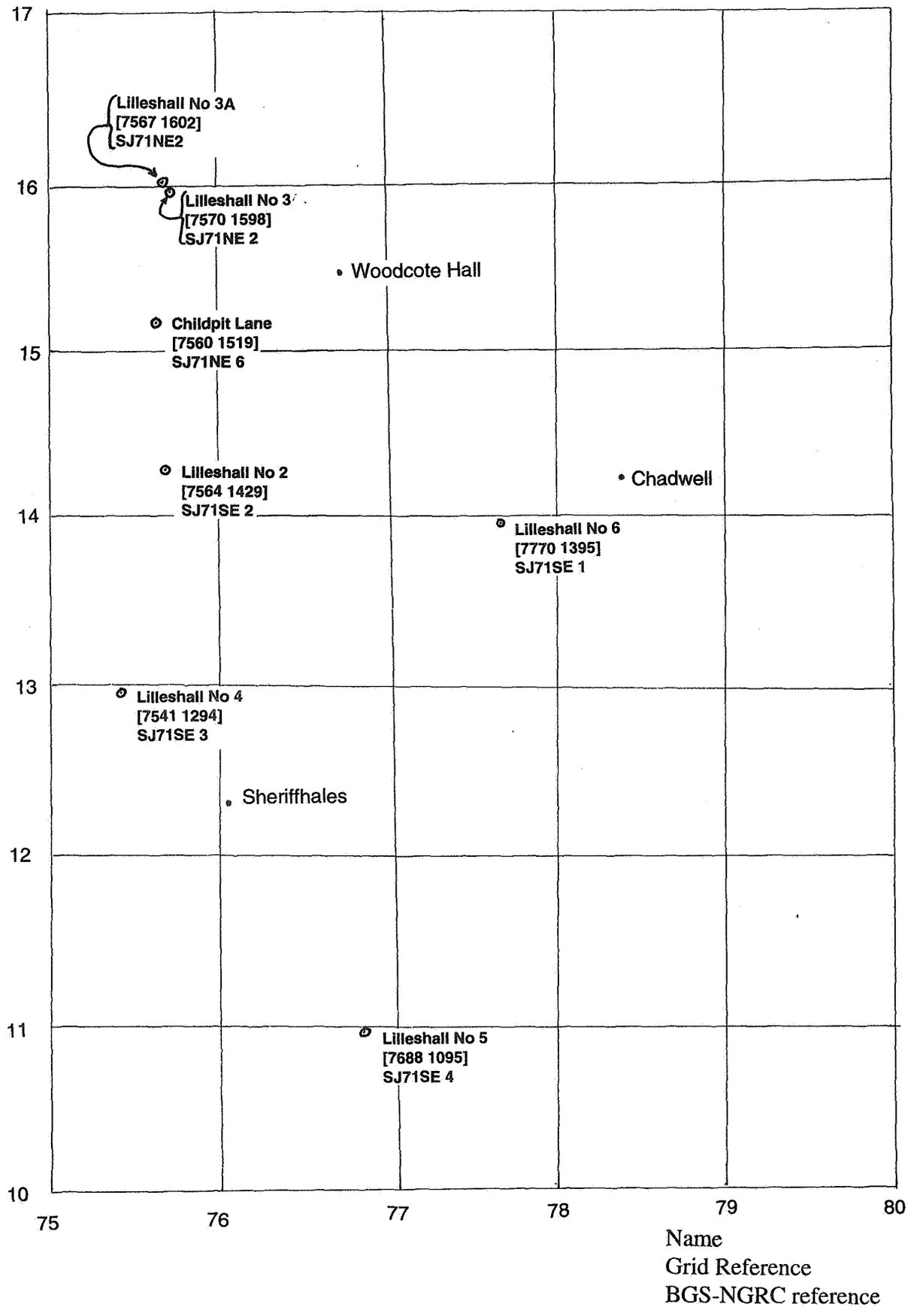

Figure 2: Location of NCB exploration boreholes referred to in text.
(Scale 1:33 333)

3. ? PRECAMBRIAN

The basal 8.5 m of strata proved in Lilleshall No. 5 Borehole were described by K C Dunham (BGS internal comm., 1948) as a 'green chloritic calcareous tuff composed of volcanic fragments cemented by coarse calcite'. Thin sections confirmed the presence of chlorite and pseudomorphs after olivine in bowlingite, both embedded in glass. Originally the tuff was assigned to the Lower Coal Measures by Dunham (BGS internal comm., 1948), a view later endorsed by Stonehouse (1950), who suggested a correlation with the basalts of Dorsley, Little Wenlock and Horsehay (all in Shropshire). However, Hamblin and Coppack (1995) considered the tuff to be much older on regional evidence, and opted tentatively for a Precambrian (Uriconian) age.

4. CARBONIFEROUS

4.1. Productive Measures

4.1.1. Lower Coal Measures (Langsettian)

The Lower Coal Measures thicken north-eastwards from 82 m (proved in Lilleshall No.5 Borehole) to a maximum recorded thickness of 123 m (not bottomed, in Lilleshall No. 6) (Figures 3 and 4). The succession comprises buff siltstone and grey mudstone, with rare coal, seatearth, sandstone and conglomerate beds. Up to twelve coal seams are recorded, of which only the Upper Lancashire Ladies, Randle-Clod, Best, Clunch and New Mine seams persist under the whole area; the New Mine Coal attains the greatest thickness (1.73 m in Lilleshall No. 2). Sandstones occur at three main levels (Figure 3). Close to the base of the sequence, the **Farewell Rock** is a grey, fine-grained sandstone with ganister, which attains a thickness of 29 m in Lilleshall No. 6 Borehole (Hamblin and Coppack, 1995). The **Crawstone Flint** is a grey-brown, coarse-grained sandstone lying beneath the Crawstone Coal. It is not present in all boreholes but is proved in Lilleshall No. 2, where it is estimated to be 3 m thick. The **Little Flint Rock**, which underlies the Little Flint Coal, is similar in lithology to the Crawstone Flint. This sandstone has only been proved in Lilleshall No. 5 Borehole, where it is 2.4 m thick.

Two marine bands occur within the Lower Coal Measures; shell fragments including *Lingula* recovered from a depth of 623 m in Lilleshall No. 2 have been equated with the Bottom Marine Band (Hamblin and Coppack, 1995). In the same borehole, a shelly fauna representing the Lancashire Ladies Marine Band lies between the Upper and Lower Lancashire Ladies Coals, at a depth of 597 m.

4.1.2. Middle Coal Measures (Duckmantian - Bolsovian)

The base of the Middle Coal Measures is marked by the Pennystone Marine Band (Figures 3 and 5), recorded 1.5 m above the New Mine Coal in the Childpit Lane Borehole (- 455.8 m OD). The succession at the basin margins is condensed (89.3 m proved in Lilleshall No. 5 Borehole) but thickens northwards into the basin (155 m proved in the Childpit Lane Borehole). Around the basin margins, local uplift and erosion prior to deposition of the overlying Etruria Formation has removed the higher parts of the succession.

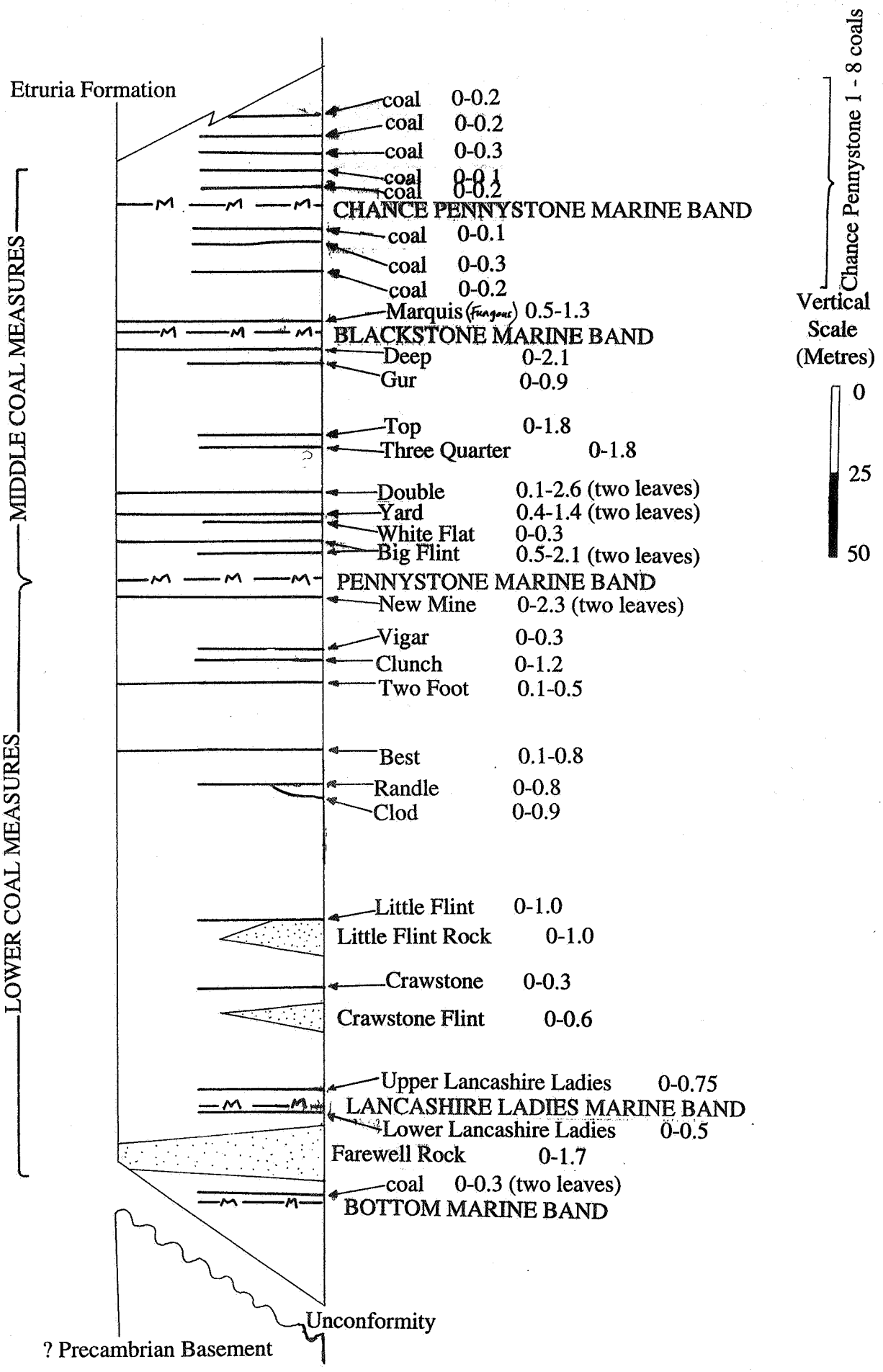

Figure 3: Composite section of Lower and Middle Coal Measures (thicknesses are in m).

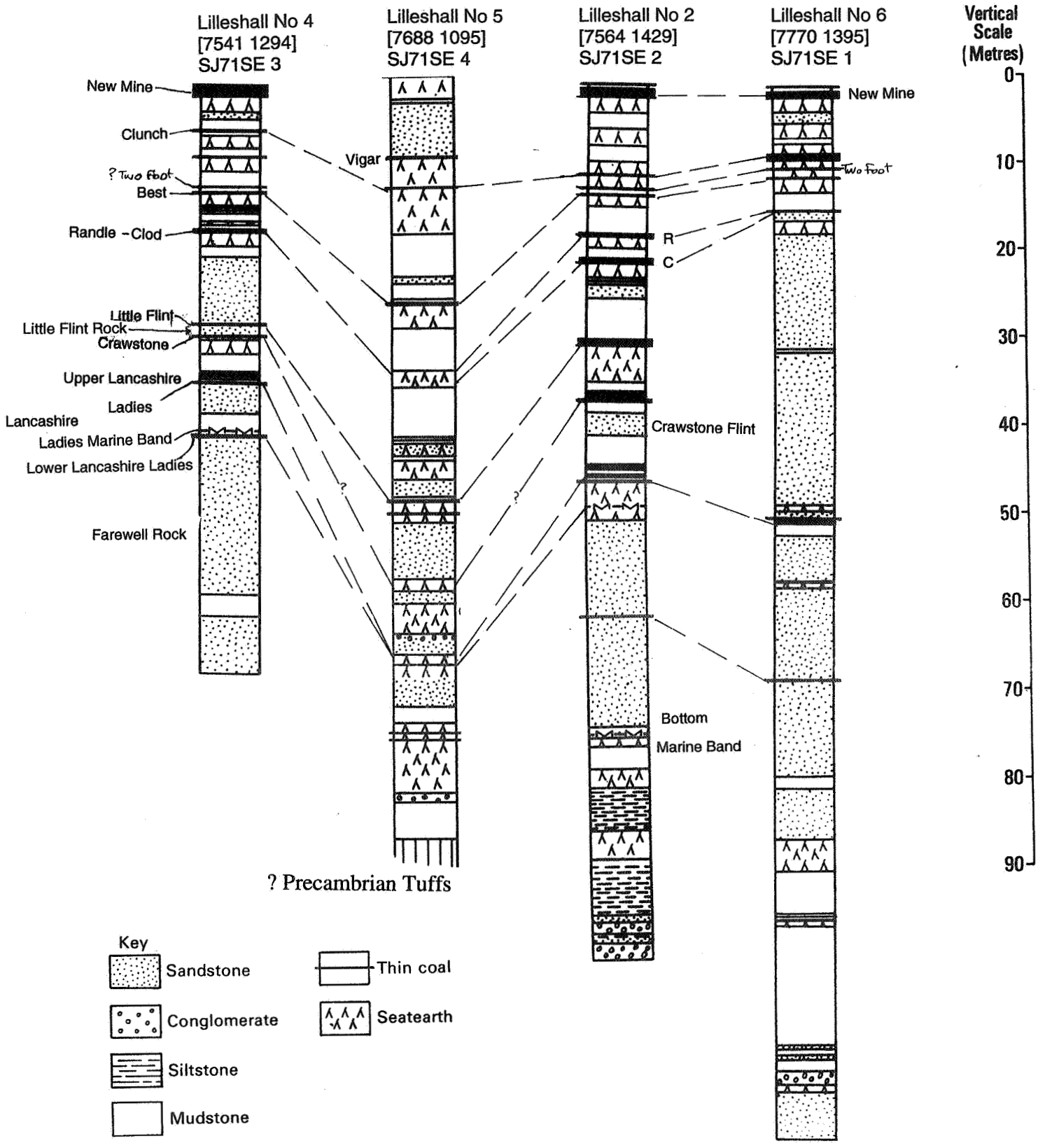

Figure 4: Comparative sections in the Lower Coal Measures (from Hamblin and Coppack, 1995)

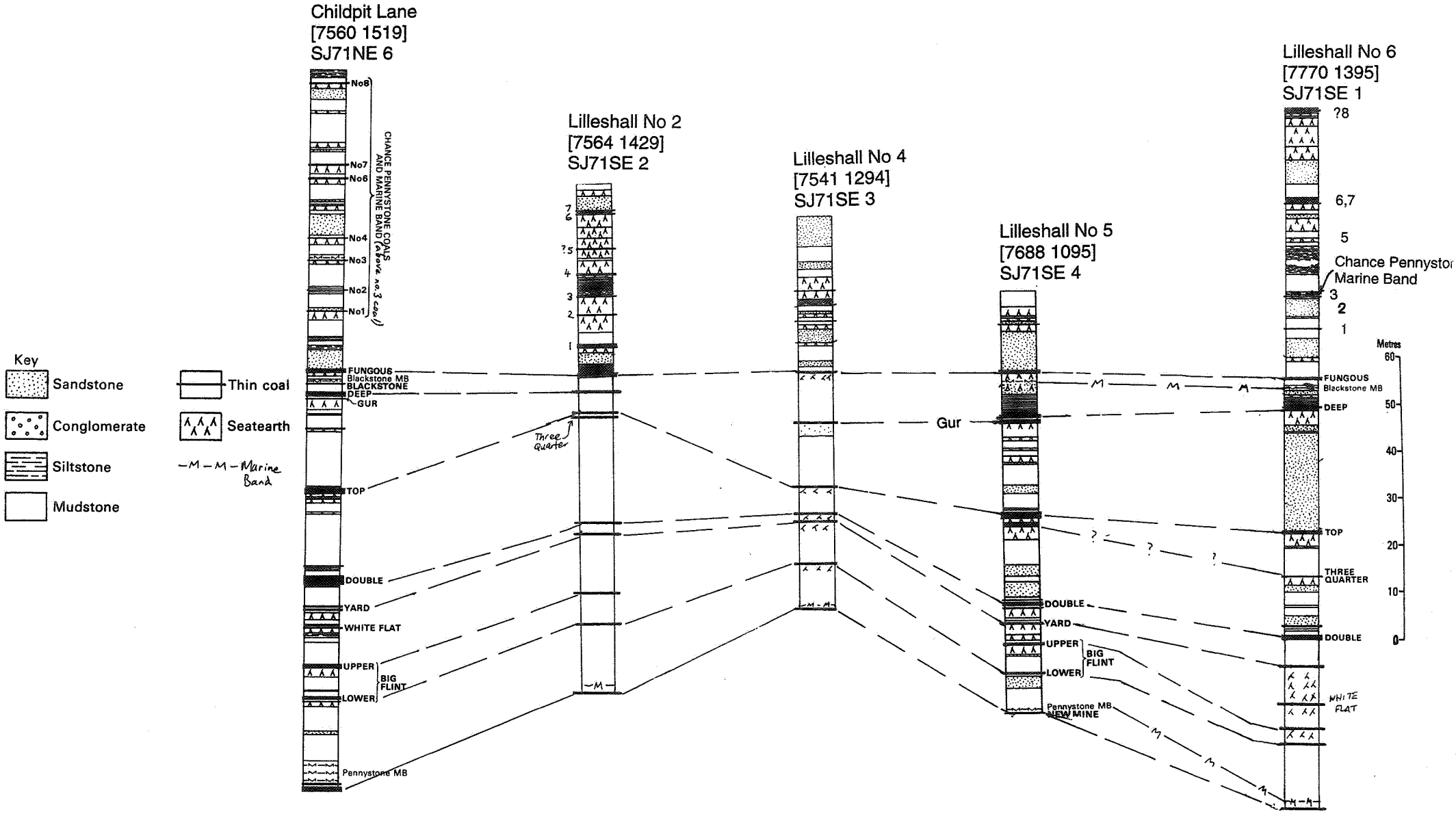

Figure 5: Comparative sections in the Middle Coal Measures
(adapted from Hamblin and Coppack, 1995)

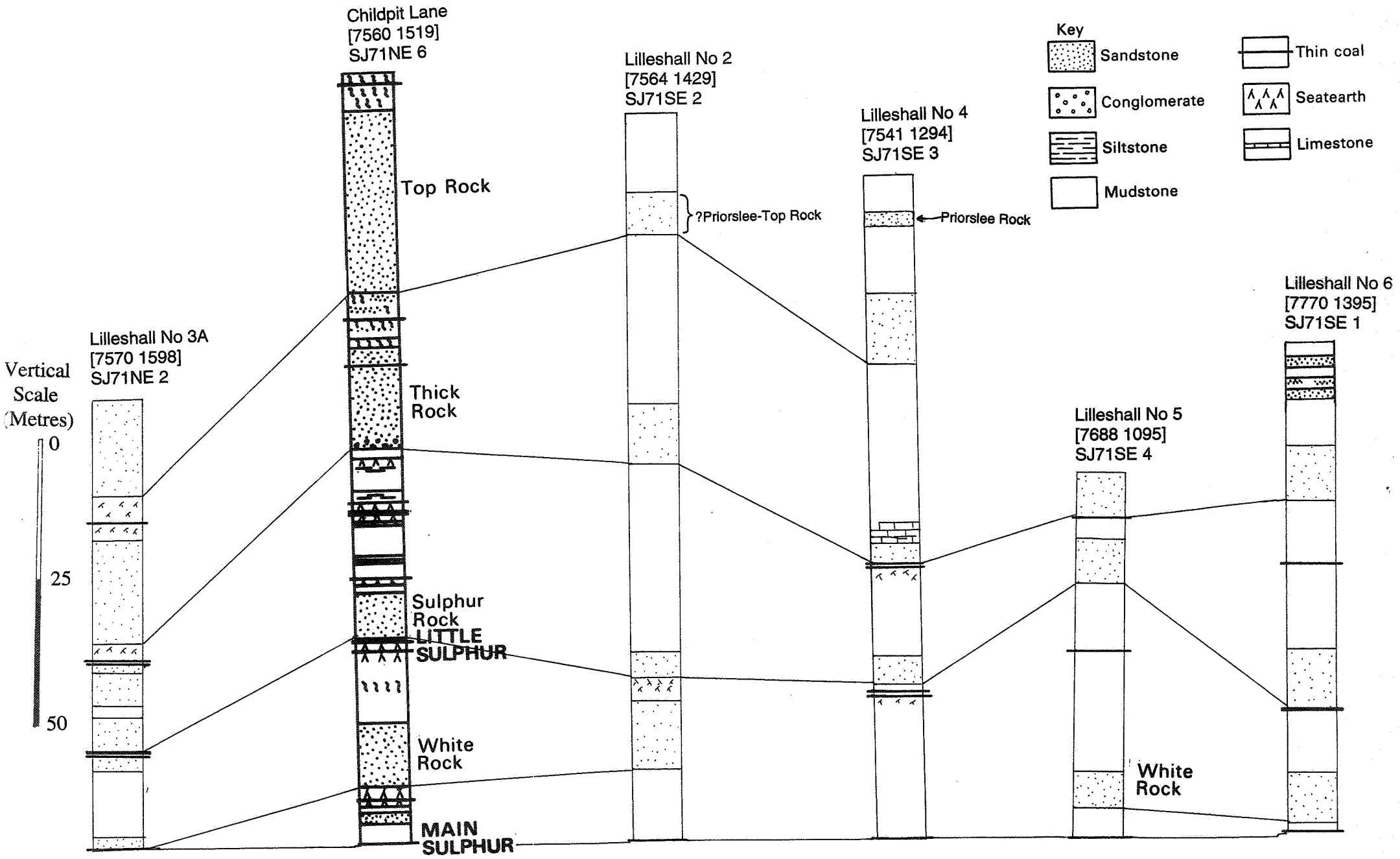

Figure 6: Comparative sections in the Halesowen Formation
(Childpit Lane log taken from Hamblin and Coppack, 1995)

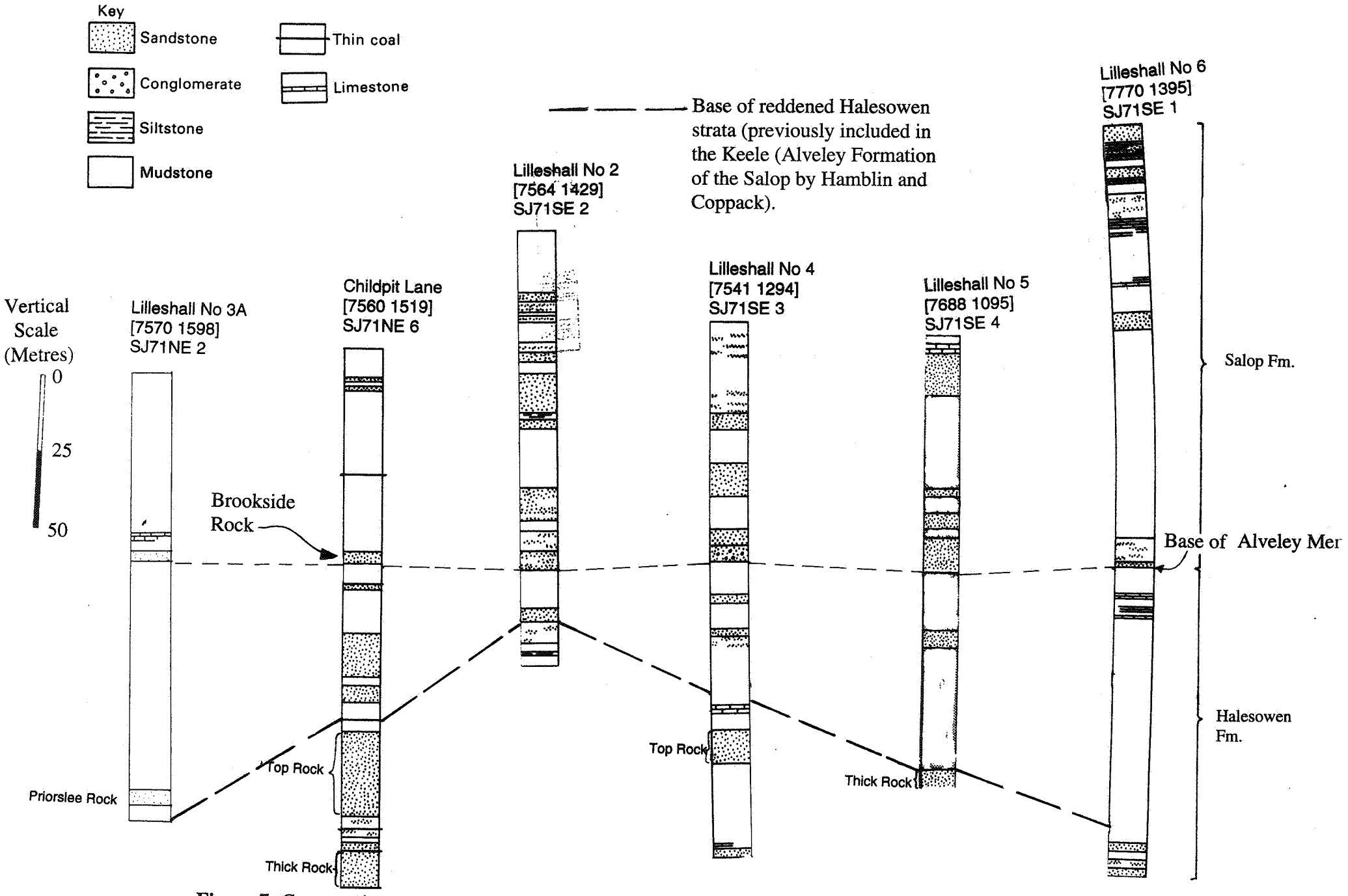

Figure 7: Comparative sections in the Alveley Member of the Salop Formation
(Modified from Hamblin and Coppack, 1995)

The division consists of sandstone, siltstone, mudstone, coal and seatearth. Nineteen coals are recorded in boreholes (Figures 3 and 4), although many are laterally impersistent, with only the Lower Big Flint, Yard, Double, Top, and Fungous (Marquis) seams showing good continuity. The thickest seam is the Double Coal (2.6 m including a 1.2 m 'dirt' parting) proved in the Childpit Lane Borehole. The eight highest coals are termed the Chance Pennystone 1-8, although in many cases these are poorly developed, or represented only by seatearth or dark grey, carbonaceous mudstone.

Apart from the Pennystone Marine Band (equivalent to the Vanderbeckei Marine Band), two other marine bands are present within the Middle Coal Measures. The Blackstone (Maltby) Marine Band lies between the Deep-Gur and Fungous (Marquis) coal seams, and the Chance Pennystone (Aegiranum) Marine Band, is found above the third Chance Pennystone coal. The marine bands are composed of dark grey mudstone with fragments of marine fossils, including the inarticulate brachiopod *Lingula.*

4.2. Barren Measures

4.2.1. Etruria Formation (Bolsovian)

The junction between the Productive Measures and the overlying Etruria Formation is unconformable west of the Sheriffhales area but becomes conformable further to the east (Hamblin and Coppack, 1995). In areas where secondary reddening of measures has occurred beneath the unconformity, the base of the Etruria Formation is ill-defined. In Lilleshall No. 2 Borehole, the base of the formation lies at a level 4.87 m above the 7th Chance Pennystone coal, whereas in Lilleshall No. 5 it is 15.85 m above the Fungous Coal.

Samples from Lilleshall No. 6 Borehole indicate that the Formation is composed of red and purple mudstone, nodular in places, with subordinate 'espley' sandstones, some with buff-green basal conglomerates. In borehole provings, the formation ranges between 5.8 and 47.2 m in thickness, the latter figure being recorded in Lilleshall No. 6. Deposition appears to have been controlled by syntectonic faulting (Stonehouse, 1950).

Mineralogically, the formation is distinguished by the presence of chlorite-bearing volcanogenic litharenites, and mudstones dominated by disordered kaolinite and low proportions of a degraded illitic clay mineral (Besley and Cleal, *In prep.*).

4.2.2. Halesowen Formation (Bolsovian-Westphalian D)

The Halesowen Formation consists of up to 128 m of calcareous sandstone and mudstone, with thin coals, and fireclays (Figure 6). The formation represents a return to coal-swamp conditions and, though dominantly in grey measures, it includes subordinate redbeds. The base of the formation is taken beneath the Main Sulphur Coal, which forms a widespread marker throughout the region, attaining a thickness of 1.07 m (in two leaves) in Lilleshall No. 6 Borehole. Above this, seam correlation is achieved by reference to five major sandstone-dominated units. The lowermost of these, the **White Rock**, lies between 1.5 and 12.1 m above the Main Sulphur Coal. It is a grey-green, massive, micaceous fine- to medium-grained sandstone, with a proven

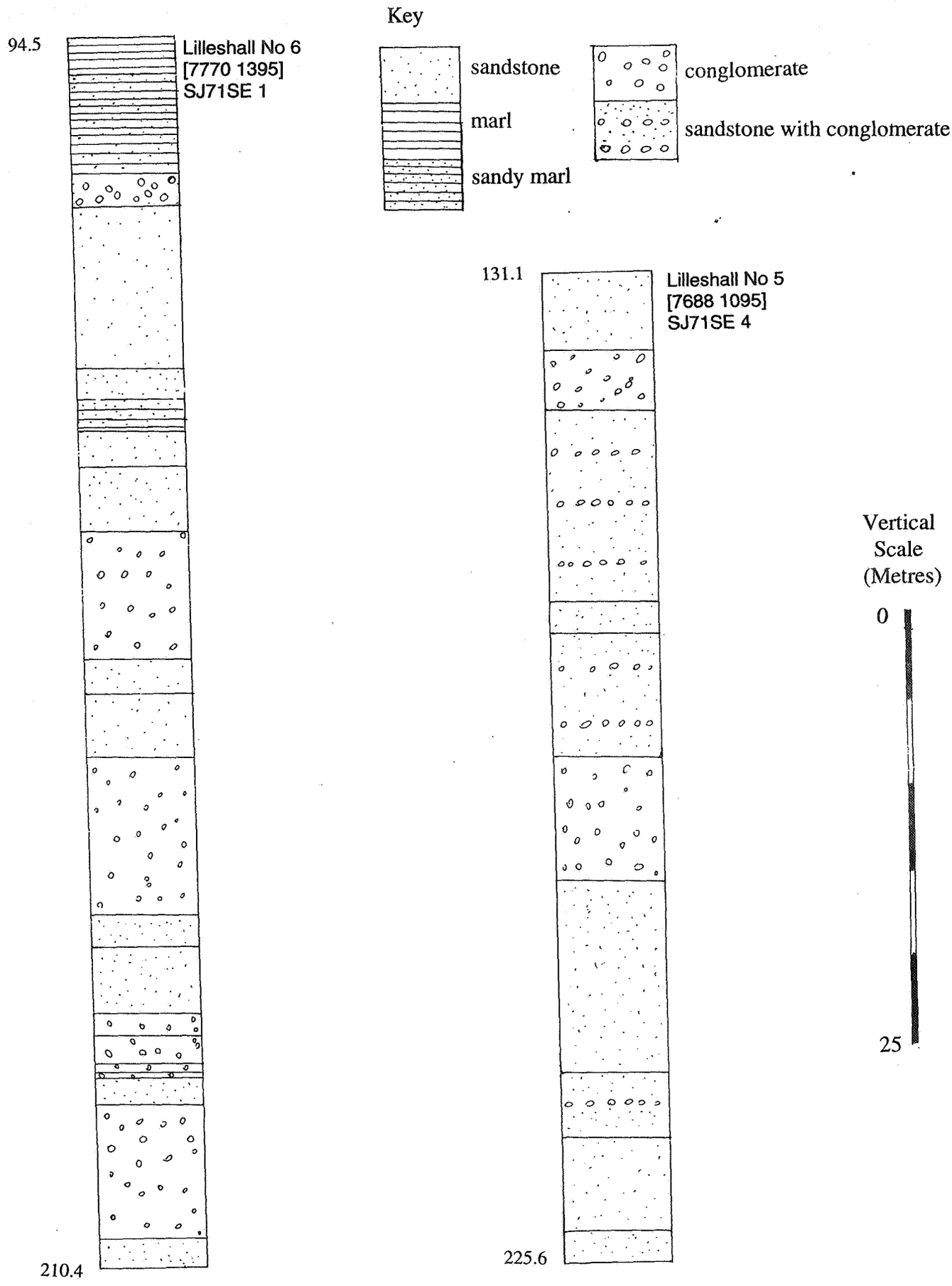

Figure 8: Comparative sections in the Enville Member of the Salop Formation (as logged by R J O Hamblin) (depths given in m below OD)

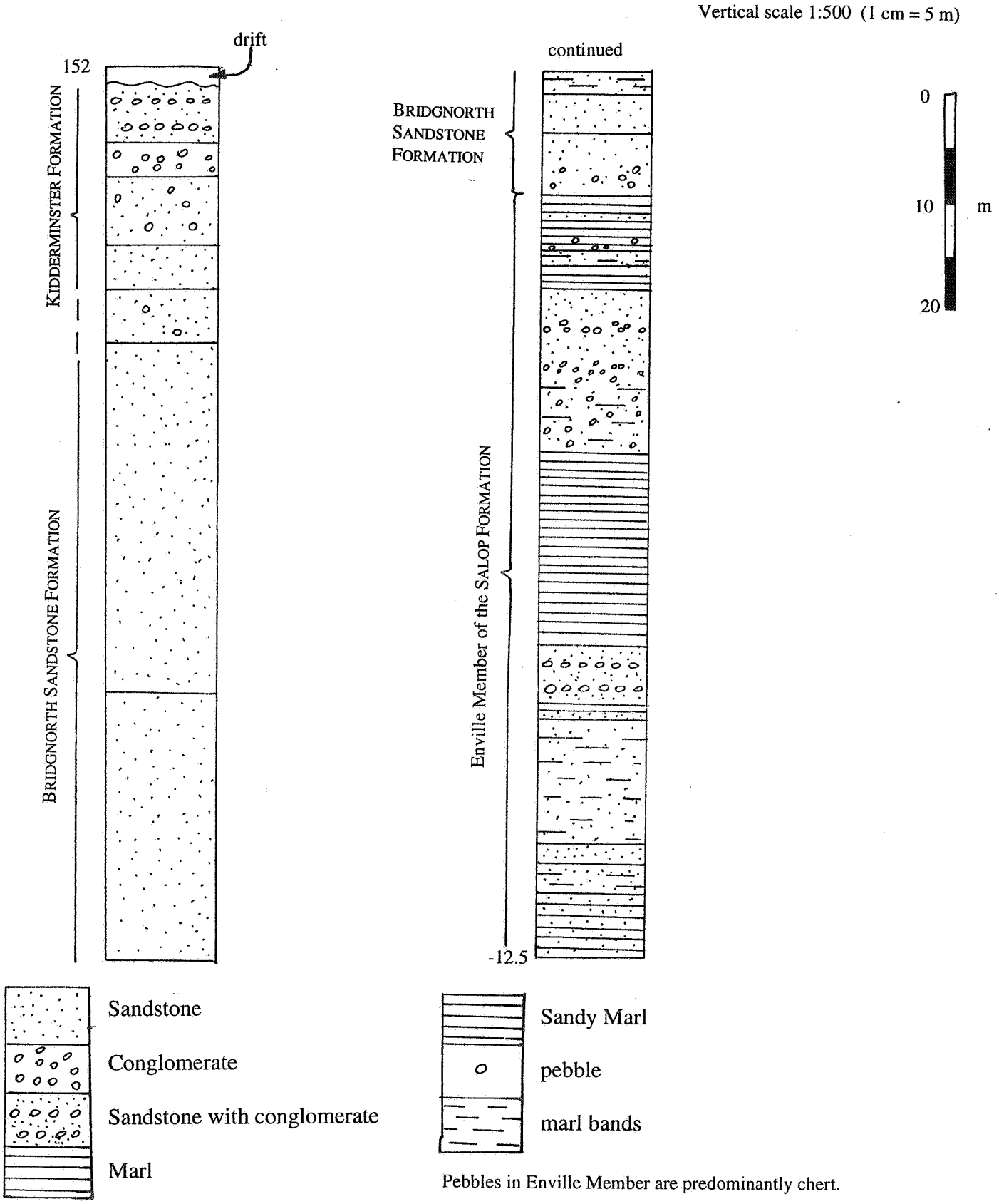

Figure 9: Log of Hilton Bank 1 (SJ71SE 6) (Enville Member of the Salop Formation, Bridgnorth Sandstone Formation and Kidderminster Formation). (Graphic log produced from paper log in Whitehead *et al.* 1928). (depths given relative to OD).

thickness of 13.7 m in Lilleshall No.2, but is absent altogether in other boreholes (for example, in Lilleshall No. 4). A sequence of red and green siltstones, up to 19.8 m thick, and including three poorly developed coals, separates the White Rock from the next higher sandstone unit, the **Sulphur Rock**. The latter, proved in Lilleshall No. 5 Borehole, is composed of 9.1 m of grey and green siltstone and sandstone. Above the Sulphur Rock is a sequence of greenish-grey calcareous mudstones with some siltier horizons and subordinate sandstone and fireclay beds, of which some 26.1 m were encountered in the Lilleshall No. 2 Borehole. The succeeding **Thick Rock,** is a red and grey, coarse-grained, calcareous sandstone, with a maximum recorded thickness of 19.8 m in Lilleshall No.3A. At the same locality (Lilleshall No. 3), about 10 m of interbedded grey, fine-grained limestone, coal and fireclay separate the Thick Rock from the grey and purple, coarse-grained sandstones that form the 18.4 m-thick **Top Rock**. This latter unit, has only been identified in Lilleshall Nos. 2, 3, 4 and Child Pit Lane boreholes. Between the Top Rock and the uppermost sandstone unit, the **Priorslee Rock,** are up to 10.6 m of mudstone (present in both Lilleshall No. 2 and Childpit Lane boreholes). The Priorslee Rock is a grey, coarse-grained sandstone, commonly calcareous. The beds above the Priorslee Rock, recorded in Lilleshall No. 4 Borehole, are composed of 45.9 m of calcareous red and green mudstone, with thin sandstone beds and coal seams.

The boundary with the overlying 'Keele Beds' was taken by Hamblin and Coppack (1995) at the upward colour change from grey to predominant red measures. At outcrop this boundary corresponds approximately to the base of a major sandstone, termed the Brookside Rock. However, in boreholes, the colour change is demonstrably diachronous transgressing to lower levels, eastwards and northwards, and cutting across a reasonably well-defined lithostratigraphy (Hamblin and Coppack, figure 16). Although Hamblin and Coppack included all redbeds below the Brookside Rock in the Keele Formation (now part of the Salop Formation), in the present account these beds are designated part of the Halesowen Formation.

4.2.3. Salop Formation (Westphalian D - Stephanian)

This formation has been newly defined to include the Keele and Enville beds of earlier workers. The formation rests conformably on the Halesowen Formation (Hamblin and Coppack, 1995), its base being taken at the base of the **Brookside Rock**, a purple-grey, variegated coarse-grained sandstone.

The Salop Formation is composed of a lower Alveley Member (Figure 7) and an upper Enville Member (figures 8 & 9). The formation is thickest in Lilleshall No. 2, which starts within the upper part of the Enville Member, and is at least 274.3 m. The Alveley Member is a sequence of red mudstones with intraformational marl-pellet breccias, caliche-rich mudstones and subordinate sandstones. Its thickness ranges from 39.6 m, proved by Lilleshall No. 3, to 161.6 m proved by Lilleshall No. 6. Besley and Cleal (in prep.) define the base of the member as the first occurrence of sublitharenites containing detrital limestone grains. The Enville Member is composed of sandstones and conglomeratic sandstones, interbedded with subordinate red mudstone. Lilleshall No. 2 proves the member to be at least 131.1 m thick.

5. PERMIAN

5.1. Bridgnorth Sandstone Formation

This comprises a red to red-orange (locally varying to brown and cream), fine- to coarse-grained, friable sandstone, with characteristic aeolian-type dune cross-bedding (Smith *et al*, 1974). The thickness of the Formation varies from an estimated 50 m at Hilton Bank 2 [7663 1256] to 73 m at Hilton Bank 1 [7631 1323] (Figure 9). Lithologies proved by the former are red and grey sandstone and marly sandstone. Hilton Bank 1 proves the basal 3.4 m to be pebbly, included within the formation due to the presence of aeolian-type grains. Above this, the formation is composed of red and grey fine- to coarse-grained sandstones with 'soft beds' (possibly siltier horizons) 5.8 m above the base. The formation rests unconformably on sandstones and mudstones of the Enville Member. In the south of the district the outcrop widens slightly due to faulting and the interaction of dip with topography.

Compositionally, the sandstone is mature, comprising over 95% quartz grains, the remainder being made up of dark grey volcanic rock fragments and creamy-white flecks of weathered feldspar. All the quartz grains and even some feldspar grains are well-rounded, are of good sphericity, and are weakly cemented by a very thin layer of iron oxide (Shotton, 1937). An exposure of the basal beds to the west of Woodcote Hill [7645 1471] shows 6.23 m of red-orange, very well sorted sandstone with well developed hummocky cross-bedding. Heterogeneous foresets trend in two predominant directions: 18°/N281° and 21°/N214°; these would have been deposited on opposite barchanoid 'wings' of a barchan-type dune system (Shotton, 1937, Leeder,1991). The upper 1.22 m of section comprises a brown, coarse-grained sandstone, with spherical and smooth-surfaced grains (the so-called 'millet seed' beds of Whitehead *et al.* 1928). Both honeycomb and onion-skin (exfoliation) weathering are exhibited at this exposure.

Exposures at mid-sequence in quarries and ice-houses to the north of Woodcote Hill [7572 1505] show lithologies comparable to the basal sections. The upper beds of the formation are exposed in small sections to the west of Muster Hill [7600 1629]. Here, the Bridgnorth Sandstone is less well sorted than the basal sections of Woodcote Hill, with some granule and clay-grade material present within the sandstone. Grains are, in general, spherical to sub-spherical, and well-cemented. Cross-bedding dips at 22°/N263°. Throughout the Formation, true bedding is obscured by cross-bedding (Shotton, 1937), and therefore cannot be measured with confidence.

6. TRIASSIC

6.1. Sherwood Sandstone Group

6.1.1. Kidderminster Formation (Induan-Olenekian)

Resting unconformably on the Bridgnorth Sandstone Formation are between about 73 and 130m of beds assigned to the Kidderminster Formation. The basal angular contact was seen during the present survey at Muster Hill along a temporary track-side exposure, and formerly was exposed

at the Hilton Bank Pit [7620 1328] (Whitehead *et al.* 1928). The formation is composed of red to red-brown, well to poorly sorted sandstone, with pebble and cobble conglomerate lenses and local thin siltstone beds. Many pebbles in the formation exhibit pitted surfaces caused by pressure solution, with numerous pits up to 1 cm in diameter and less than 1 mm deep, indicating the formation has been subject to substantial tectonic stress (Leeder, 1991).

A basal conglomerate (up to 3 m in thickness) forms a prominent escarpment running north-south 200 m to the east of Sheriffhales and faulted westwards against the Enville Member to Muster Hill. Other strike-parallel escarpments occur from Hungerhill Plantation to Burlington Wood, and further to the east at Gorsey Bank. These probably relate to resistant conglomerate bands in the formation; this was confirmed by a small digging at Kingstreet Grange [7734 1359] which exposed 3.05 m of conglomerate containing cobbles up to 0.2 m in diameter. A 4° dipslope formed by the basal conglomerate is best developed in the Heath Hill area, where it extends eastwards for up to 700 m before becoming obscured by sandy till. The basal conglomerate is not present in Hilton Bank 1 borehole (Figure 9), where the lowermost 5.5 m of the formation, recorded as containing 'hardly any pebbles', is overlain by 3.8 m of non-pebbly sandstone. Where drift cover is absent, the Kidderminster Formation generally gives rise to an extremely pebbly soil, as seen on the eastern slopes of Muster Hill.

6.1.2. Wildmoor Sandstone Formation (Induan-Olenekian)

The Wildmoor Sandstone outcrop occupies a low-lying tract of land formed between the high ground of the Kidderminster and Bromsgrove Sandstone formations. The junction with the underlying Kidderminster Formation is transitional, the base being taken at the onset of pebble-free sandstone. Typically it is a red-orange, fine-grained sandstone, pebbly in the lower part, with grey mottling throughout. The Chadwell Grange Borehole [7833 1413] proved 56 m of a 'red marly rock with stone', interpreted as Wildmoor Sandstone due to its position above definite Kidderminster-type lithologies. The lower part of the formation is exposed along an unnamed tributary of the Worfe, draining south from Burlington Pool; here it is an orange to brown, micaceous, fine- to medium-gained sandstone, medium bedded in part. The upper part of the formation, exposed at Lodge Farm [7912 1171] is a yellow-orange, fine grained silty sandstone. In augered samples, the Wildmoor Sandstone is a bright red, micaceous silty sand which may be moulded by hand.

6.1.3. Bromsgrove Sandstone Formation (Ansian)

Regional mapping of the Bromsgrove Sandstone Formation shows it to be locally unconformable on the Wildmoor Sandstone around the basin margins but conformable further into the Stafford Basin. The Formation consists of at least 30 m of brown and buff, fine- to medium-grained sandstone with subordinate mudstone. In a disused quarry at Great Chatwell [7952 1471], up to 5.8 m of red-buff, well cemented sandstone is interbedded with red, green and grey siltstone showing low angle planar cross-bedding. This sequence rests on 1.36 m of buff coarse-grained sandstone with occasional pebbles of quartz, quartzite and limestone (described in Whitehead *et al.* 1928)). Boreholes show the exposure to be approximately 1.5 m above the base of the formation. The beds dip at 6°/N061°, with cross-bedding indicating north-westerly and easterly

prevailing current directions. At Mount Quarry [7975 1143], which affords sections in the lower part of the formation, lithologies are considerably more micaceous than at Great Chatwell, and generally finer grained. Planar cross-bedding is evident in the sandier horizons.

7. QUATERNARY

7.1. Till

Both Till and Sandy Till have been mapped in the area. Morgan (1973) states that the drift is derived from the local bedrock, and this assumption is supported in the district by the restriction of Sandy Till to areas less than 900 m from the crop of the Kidderminster Formation.

Till occurs over two broad tracts of ground in the district; one to the west of the Kidderminster escarpment, and another separate spread on the more subdued topography formed by the Wildmoor Sandstone outcrop. Where exposed, for example at Lower Beighterton [7977 1260], Till is an unordered mixture of buff stony clay with ill-defined patches of sand, gravel and sandy clay. Augered samples from the east of the district proved clay varying from brown to red and less commonly yellow and green, with a clasts ranging from a few granules of sand, to gravels and cobbles with negligible clay and silt fractions. Quartz and quartzite pebbles derived from the Kidderminster Formation are abundant, with rarer pebbles of granite, flint, limestone and dolerite. The Till cover tends to mask bedrock features, and forms a flat featureless plain around White Sitch.

7.2. Sandy Till

The occurrence of Sandy Till is confined essentially to the dip-slopes of the Kidderminster Formation and parts of the less well featured Wildmoor Sandstone Formation. Identified solely by augering, Sandy Till is a mixture of sand, silt and pebbles with rare sandy clay patches. Where it overlaps the Kidderminster Formation, the boundary is marked by a slight concave break in slope. The thickness of Sandy Till is variable, apparently increasing into valleys incised in the Kidderminster Formation. A shallow borehole at Chadwell Grange (SJ 71 SE 9) proved 7.47 m of sand, sandy marl and sand and gravel, and a water well north of Kettlemore Lane (SJ 71 SE 7) proved 4.73 m of hard clay with stones and gravel layers.

7.3. Glaciolacustrine Deposits

Clays and Laminated Clays of probable glaciolacustrine origin (Whitehead *et al.* 1928) have been identified between Great Chatwell and Lynn. Augering proved a soft brown, plastic clay which is easily smeared. In places, the clay is laminated orange and grey, and one sample (from [7913 1518]) was pebbly. The clay bodies appear to overlie Till, and may be up to 3 m thick 150 m west of Guy's Bank.

7.4. Glaciofluvial Deposits

Deposits classified as Glaciofluvial Deposits include all unconsolidated sand and gravel

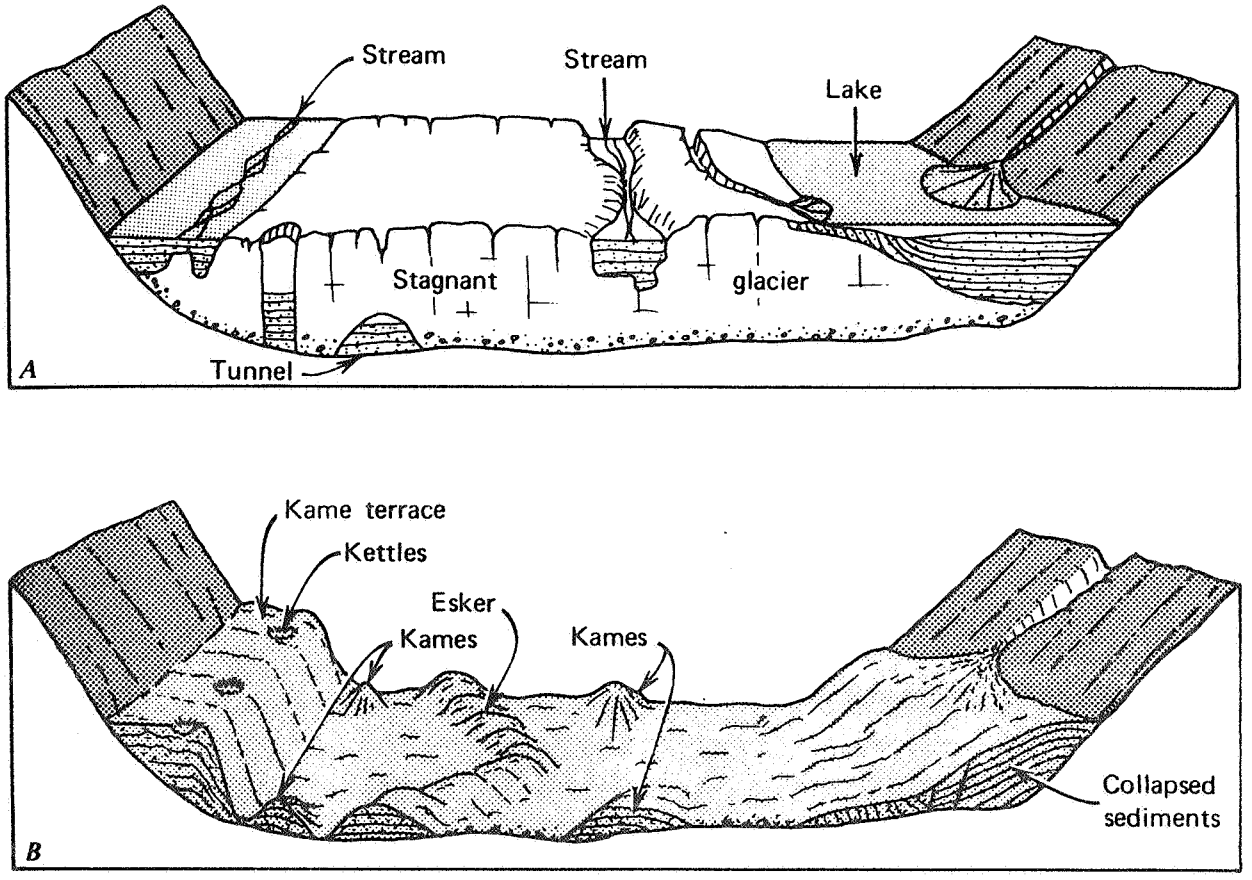

Figure 10 Origin of bodies of ice-contact stratified drift. *A*. Stagnant glacier ice affords temporary retaining walls for bodies of sediment built by streams and in lakes. *B*. As ice melts, bodies of sediment are let down and in the process are deformed.

(From Flint, 1971.)

outcrops. Most are presumed to have been laid down as ice-contact deposits (Whitehead *et al.* 1928), as evidenced by steep north-facing flanks; however some of the landforms may have formed in a proglacial setting beyond the ice margin. A model for their deposition is given in Figure 10 (taken from Flint, 1971), which depicts several of the features present at Lynn [7846 1579]. Deposits between Stockton Moors [7802 1695] and Woodlands [7970 1045] form part of the 'Newport Esker Chain' (Whitehead *et al.* 1928). Within this complex, the dominant landforms are kame-like mounds up to 6 m high of fine-grained orange, red and yellow sand and gravel; these are best developed between Lynn and Chapman's Wood [7952 1644] in the north of the district. A sinuous esker, up to 8 m high and trending south-east sub-parallel to Moreton Brook [7855 1634], can be traced for at least 700 m, and is the only well defined esker within the complex. Sand and gravel has been extracted from the southern tip, where the chaotic relationship between clasts is indicative of collapse and deformation of strata after ice-melt. Ice-wedge casts infilled with gravel cut the main sand and gravel body of the esker. East of Dawford Brook [7898 1542], Glaciofluvial Sand overlies Glaciolacustrine Clay; elsewhere the sand and gravel mounds rest on bedrock, Till or Sandy Till.

Between Burlington Cottages [7762 1117] and the A41 lies a broad, gently undulating gravel sheet. The margins of this deposit, which close northwards, suggest a depositional source to the north, and it seems likely that the gravel was deposited as outwash from a stream which ran through a channel between Hungerhill Plantation and Kettlemore Lane [7723 1264]. South of Burlington Cottages a cover of hummocky Sand and Gravel, resting on the Kidderminster Formation, joins the outwash body to the east. The western margin of the deposit is marked by a concave break in slope against the Kidderminster Formation. The deposit is a mixture of red and orange sand with some gravel-rich patches. A borehole at Crackleybank Farm (SJ 71 SE 24) proved the deposit is up to 4.87 m thick, comprising sand and gravel with occasional marl layers.

A digging in a sand body 300 m north of Crackleybank Farm [7681 1122] exposed an extremely well sorted deposit of polished spherical and well rounded quartz sand. The grain morphology is similar to that of the 'millet seed' beds of the Bridgnorth Sandstone Formation, which, if it was derived from the basal Bridgnorth Sandstone, indicates sediment was transported up to 1 km eastwards by glaciofluvial processes.

7.5. Alluvium

The district, covering part of 'The watershed of England' (Whitehead *et al*, 1928), between the catchment areas of the Severn and Trent basins, has south- and east-draining streams which link via the Worfe, to the Severn, and north draining streams which eventually join the Trent. The former occupy small valleys, and are bordered by thin strips of alluvium up to 100 m wide composed of silt and clay, locally with lenses of sand and gravel. The complex of streams flowing northwards occupies a broad, shallow valley trending northwards from Lynn Mill Farm. Here, a spread, up to 900 m wide, of dark, peaty alluvium with occasional yellow sand and grey clay lenses has apparently cut through older glaciofluvial deposits forming an alluvial flat.

7.6. Peat

Peat occurs as small irregular shaped bodies (up to 110 m in diameter), notably within the alluvial tract at [7917 1636], overlying Sandy Till at [7884 1408] and overlying Till at [7928 1571]. The last example is a kettle, 50 m in diameter and up to 5 m deep, and would have formed when a buried block of ice, detached from the retreating ice-sheet, melted out (Bates and Jackson, 1987).

8. STRUCTURE

The lithostratigraphy can be divided into three main structural units; namely, the concealed extension to the Coalbrookdale Coalfield; the red bed sequences resulting from Variscan (late-Westphalian-Stephanian) basin inversion; and the post-Carboniferous rift sequence of the Stafford Basin.

Dips in the Enville Member vary between 7-10° to the east or south-east. In the Permo-Triassic succession, eastward dips of around 5° on the Kidderminster outcrop lessen downdip. In most exposures, cross-bedding hampers measurement of the true dip.

The Barren Measures are displaced by a series of east- and north-east-trending faults. Most terminate beneath the Permo-Triassic cover, although the Brewer's Oak Fault and an unnamed fault 500 m to the north throws the Bridgnorth Sandstone against Enville Member beds in a small graben.

The Woodcote Hall Fault can be traced south-eastwards from Pave Lane to Woodcote Hill. It throws Bridgnorth Sandstone and Kidderminster Formation down north-eastwards against strata of the Enville Member. The Kidderminster Formation form a prominent ridge along Muster Hill, where it terminates against a north-west-trending fault which throws down to the north an estimated 70 m.

A fault defined on seismic evidence trends north-east 500 m north of Woodlands [7975 1095]. Augered samples of Wildmoor-type red sand and brown Bromsgrove-type sand either side of a shallow gully proved the fault, which downthrows about 20 m to the north-west.

The principal structures affecting the Coal Measures are the Donnington and Crackley Bank synclines, both of which have a Caledonoid trend; further details of these are given in Stonehouse (1950) and Hamblin and Coppack (1995).

9. ECONOMIC GEOLOGY

9.1. Coal

None of the coal seams proved at depth has been worked in the district, although they have been extensively worked further to the west within the Coalbrookdale Coalfield.

9.2. Sand and Gravel

Sand and gravel was formerly extracted from the Kidderminster Formation at the Burlington Gravel Pit by Amey Roadstone. Sand and gravel was dug, crushed, then washed on site. Extraction ceased when a hard layer was encountered which required blasting to yield gravel. Two pits were worked [7718 1228, 7708 1184] before the site was restored in 1980.

No commercial exploitation of Quaternary sands and gravels has taken place (presumably due to an unpredictable clay content) although part of the Newton Esker Chain [7877 1622] has been dug for local use.

9.3. Building Stone

Numerous disused quarries in the Bridgnorth Sandstone are found to the west of Woodcote Hill. The stone is widely used in local houses, and forms the boundary wall of the former Woodcote Estate.

10. MAN-MADE DEPOSITS

10.1. Made Ground

By far the most extensive area of Made Ground is an area between Burlington Wood and the A41 (centred at [7755 1186]). Here, a mound of washings from gravel extraction operations at the Burlington Gravel Pits covers approximately 8.75 hectares, and is up to 3 m in height. The deposit is composed of a fine-grained, red, micaceous, silty sand.

Low road embankments on the A5 [7813 1089] and the A41 [7929 1151], and embankments up to 4 m high around several recently constructed reservoirs constitute the other mapped areas of Made Ground in the district.

10.2. Made and Worked Ground

Pits at Hilton Bank [7620 1328] and west of Woodcote Hill [7638 1466] have been backfilled with unknown material. An ornamental pond complex involving both Made Ground and Worked Ground has been completed recently 200 m south of Woodlands [7972 1026].

10.3. Disturbed Ground

An ancient settlement west of Pave Lane [7562 1638] is composed of ill-defined banks rarely exceeding 1 m in height. Another area of disturbed ground lies to the west of Burlington House [7725 1126] and consists of old foundations, diggings and low mounds.

11. GEOLOGICAL HAZARDS

This section is intended as a summary of the principal geological hazards identified in the area

at the last date of survey. It is not exhaustive and should not be used under any circumstances to replace any part of a geological investigation.

Unconsolidated deposits in the area include **peat, alluvium, till, glaciolacustrine clay, glaciofluvial sand and gravel, made ground,** and **worked and made ground.** These deposits are heterogeneous, and can be highly compressible compared to the local drift or bedrock, and could give rise to excessive and differential settlement of superposed structures. For this reason particular care should be taken in the siting of any construction on drift deposits in the Sheriffhales area.

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13. APPENDIX

13.1 Summary sections of selected boreholes

Depths refer to base of units in metres relative to Ordnance Datum (OD). Full sections may be consulted in the National Geosciences Record Centre (NGRC) at the British Geological Survey, Keyworth, Nottingham NG12 5GG.

NGRC Unique Number	SJ71SE.1	SJ71SE.2	SJ71SE.3	SJ71SE.4
Borehole Name	Lilleshall 6	Lilleshall 2	Lilleshall 4	Lilleshall 5
National Grid Reference	[7770 1395]	[7564 1429]	[7541 1294]	[7688 1095]
Kidderminster Formation	83			35
Bridgnorth Sandstone Formation	15			-29
Salop Formation	-356	-128	-106	-279
Halesowen Formation	-427	-247	-215	-341
Etruria Formation	-474	-277	-243	-384
Middle Coal Measures	-622	-403	-345	-462
Lower Coal Measures				-544
Horizons in the MCM:				
Chance Pennystone 8				
Chance Pennystone 7	-494	-281		
Chance Pennystone 6	-494	-282		
Chance Pennystone 5	-500	-289		
Chance Pennystone 4		-294	-231	
Chance Pennystone Marine Band	-514	-298	-189	
Chance Pennystone 3	-514	-298		
Chance Pennystone 2	-521	-332	-263	
Chance Pennystone 1	-527	-309	-265	
Fungous-Marquis	-532	-314	-274	
Blackstone Marine Band	-534	-316		-391
Blackstone			-278	
Deep	-538	-320		-399
Gur			-285	
Top	-565	-343	-306	-419
Three Quarter	-574	-343		
Double	-587	-365	-315	-438
Yard	-593	-369	-316	-442
White Flat	-599			
Upper Big Flint	-604	-380		-447
Lower Big Flint	-609	-387	-330	-453
Pennystone-Vanderbeckei Marine Band	-622	-404		-461
Horizons in the LCM				
New Mine	-626	-404	-346	
Vigar				-469
Clunch	-633	-415	-350	-473
Two Foot	-634	-416	-353	
Best	-635	-416	-356	-486

Randle	-638	-421	-357	-493
Clod	-638	-424	-361	-493
Little Flint		-433	-372	-507
Crawstone		-439	-373	
Upper Lancashire Ladies	-678	-448	-379	
Lancashire Ladies Marine Band				
Lower Lancashire Ladies		-452	-385	
Bottom Marine Band		-477		
				9.1 m Precambrian tuff at base
Base of Borehole	-745	-502	-412	-553
				3 other coals at -285, -533, -534
OD	110+	146	126	102

	SJ71NE.2	SJ71NE.6	SJ71SE.6	SJ71SE.7
NGRC Unique Number				
Borehole Name	Lilleshall 3A	Childpit Lane	Hilton Bank 1	Hilton Bank 2
National Grid Reference	[7570 1598]	[7560 1519]	[7631 1323]	[7663 1256]
Kidderminster Formation			?131 - ?125	80
Bridgnorth Sandstone Formation			58	?30
Salop Formation	-10.9	-103		
Halesowen Formation	-105.4	-231		
Etruria Formation	-143 (faulted?)	-300		
Middle Coal Measures		-455		
Lower Coal Measures				
Horizons in the MCM:				
Chance Pennystone 8		-302		
Chance Pennystone 7		-319		
Chance Pennystone 6		-322		
Chance Pennystone 5		faulted out?		
Chance Pennystone 4		-335		
Chance Pennystone Marine Band		-340		
Chance Pennystone 3		-339		
Chance Pennystone 2		-347		
Chance Pennystone 1		-352		
Fungous-Marquis	-146	-366		
Blackstone Marine Band		-368		
Blackstone	-148	-369		
Deep	-152	-373		
Gur	-158	-373		
Top	-167	-394		
Three Quarter		-395		
Double		-415		
Yard		-421		
White Flat		-425		
Upper Big Flint		-433		
Lower Big Flint		-440		
Pennystone-Vanderbeckei Marine Band		-455		
Horizons in the LCM				
New Mine		-460		
Vigar				
Clunch				
Two Foot				
Best				
Randle				
Clod				
Little Flint				
Crawstone				
Upper Lancashire Ladies				
Lancashire Ladies Marine Band				
Lower Lancashire Ladies				
Bottom Marine Band				
Base of Borehole	-313	-461	-12.5	1
OD	111	133	152	124