Hulme Quarry, Cannock Chase, Staffordshire

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Introduction

The 'Hulme Quarry' GCR site exposes the Cannock Chase Formation of the Sherwood Sandstone Group resting unconformably upon Carboniferous or Permian rocks. The formation comprises texturally mature pebble/cobble conglomerates, arranged in poorly sorted horizontal sheets or better-sorted cross-bedded sets. Thick sheets of conglomerate are associated with interbedded sandstones, in coarsening-upwards units. Rapid lateral fades changes from conglomerate to sandstone are also seen. Comparison with recent fluvial sediments indicates that the Cannock Chase Formation was deposited in a substantial braided stream system carrying coarse-grained material from uplands to the south and south-west. This is, therefore, an important site for the study of Early Triassic palaeoenvironments and palaeogeography.

The unconformity underlying the Cannock Chase Formation in the quarries near Hulme was briefly described by Gibson (1905). The sedimentology of the formation was described by Hull (1869, pp. 50–1), Stevenson and Mitchell (1955), Steel and Thompson (1983), and Rees and Wilson (1998, pp. 77–9, 82).

Description

Four substantial exposures are located within the Park Hall Country Park: Hulme South West Quarry (also known as the 'Gulch Quarry'), Hulme West Quarry, Hulme Central North Quarry (also known as the 'Play Canyon'), and Hulme East Quarry (Figure 3.51).

In their measured sections (Figure 3.51), Steel and Thompson (1983) identified five lithofacies divisions within the pebble beds, termed facies A–E. In the Hulme quarries lithofacies C accounts for more than 50% of the exposure, while facies A and B are less important, and facies D and E are rarely seen. The sequence rests unconformably on elastic sediments of Carboniferous to Permian age.

Facies A consists of horizontally stratified conglomerates that occur in poorly developed horizontal, or low-angle, beds. The beds range in thickness from 1–5 m, and are typically between 1 and 3 m thick. The conglomerate commonly occurs as a chaotic jumble of poorly sorted pebbles, which may show clast- and matrix-supported fabrics, and each bed is separated by a thinner sandy unit. Of lesser importance are beds characterized by poorly defined graded bedding, or graded alternations between coarse- and fine-grained, clast-supported material. Rarely, the beds rarely show clearly defined grading, but sharp breaks commonly occur between the upper and lower parts of the beds. Pebble imbrication is common.

Facies B, characterized by cross-stratified conglomerates with rhythmic patterns in the textures and structures, forms beds approximately 2 to 5 m thick. These units generally occur as composite sequences that may be interbedded with sandstones. The facies B conglomerates display well-developed planar cross-bedded and trough cross-bedded units. The planar cross-beds range from less than 1 m to more than 4 m thick. The thicker units may extend laterally for more than 100 m. The trough cross-bedded sediments are not as common as the planar cross-beds, and are associated with scour structures. The foresets of facies B consist of a conglomerate of small pebbles, which is clast supported, and grades up from the coarser-grained material or infills erosional scours, generally in the upper parts of the foresets. In places, the conglomerate is coarser grained and matrix-supported, and in this situation, the lower boundaries are generally sharp and clearly defined, but may be gradational. Some of these conglomerates pass laterally into siltstones and silty sandstones.

Facies C is typified by cross-bedded, medium-grained sandstones, with varying amounts of pebbles. The sheet-like sand bodies are well exposed in the middle of the eastern wall in Hulme Central North Quarry. The cosets are between 2 and

5 m thick; some represent broad channel fillings and overlie erosion surfaces. Sedimentary structures include tabular and lenticular planar cross-beds, up to 1.5 m thick. Some of the trough cross-beds may be interbedded with pebble lag deposits and troughs infilled with gravel. Re-activation and erosion surfaces are common, and are often associated with coarse-grained lags. Large angular fragments of argillaceous sediment (facies E) are present in the bases of some of the sets. These clasts may show imbrication or penetrate into the underlying beds. Single sheets (2 to 5 m thick) of trough cross-bedded argillaceous sediment, thin lenses of pebbly sandstone with sharp bases and erosional upper surfaces, and thick wedges of cross-bedded pebbly sandstone are common throughout this facies.

Fades D consists of argillaceous and fine-grained, cross-bedded sandstones, some with slump structures. These sediments occur as thick and thin sandstone sheets, and laterally wedging units often associated with conglomerates. The thick sheet sandstones are characterized by trough and planar cross-bedding, and the foresets are often marked by yellow and green streaks. Soft-sediment deformation structures are common. The thin sheet sandstones consist of lenticular planar sets up to 0.75 m thick, and contain gravel lenses and stringers. The thick wedges are best seen at the base of large cross-bedded sets in Central North Hulme Quarry.

Facies E is dominated by fine-grained, parallel-bedded sandstones, with interbedded red micaceous shales and argillaceous silty-sandstones. The beds of this facies are typically laterally impersistent, reach a maximum thickness of 1 m, and are interbedded with facies C and D, or occur as drapes in the gravel troughs and bottom sets of facies B.

The pebble types do not vary between lithofacies; they consist of quartzite, with smaller proportions of vein quartz, and minor amounts of sandstone, chert, rhyolite, agate, and rhyolitic tuff. Occasional reworked ventifacts have been identified (Thompson, 1970a; Steel and Thompson, 1983).

Interpretation

The interbedded conglomerates and sandstones of the Cannock Chase Formation were deposited in part of a complex braided river system (Steel and Thompson, 1983). Palaeocurrents indicators record flow generally to the north and north-west, and hence derivation of clastic material from the south and east, in part of the 'Budleighensis River' system (Figure 3.50).

Lithofacies A, characterized by coarse grains and poor sorting, indicates accumulation under high-energy conditions in areas of low relief in the braided stream system, probably in flows with a high sediment content. It is likely that the chaotic beds were deposited during episodic events, probably on the tops of bars during peak-flow conditions. The beds with clearly defined internal structures resulted from longer-term events or continuous flow and accumulated on the edges of the bars, through a combination of reworking and falling-stage flow.

Facies B formed as coarse-grained sediment avalanched down the slip slope of bars, and is related to a decline in the ability of the river to carry large clasts as discharge decreased. There may have been some degree of sorting of gravels on the top of the bars before avalanching.

Facies C and D were deposited in broad channels. The tabular and lenticular planar cross-beds and trough cross-beds represent the migration of sandwaves in the channels. Mudstone intraclasts were formed as river banks collapsed, allowing erosion of overbank sediments or those in abandoned channels, and the coarser-grained materials were deposited during flood events, and may have undergone varying degrees of reworking or winnowing. The soft-sediment deformation structures of facies D were formed under conditions of increased pore-water pressures.

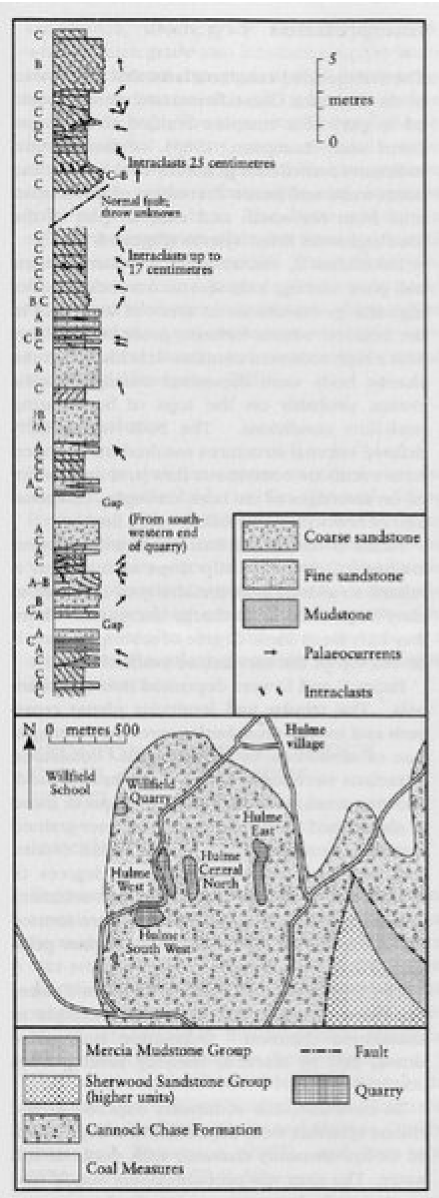
The argillaceous sediments of facies E were deposited in ephemeral pools, for example in abandoned channels. Deposition took place slowly, first by traction, then by settling from suspension.

To conclude, the sediments exposed at the Hulme quarries were deposited in a large braided or low-sinuosity channel, with pools of still water. The river was probably deep, and flowed continuously, but with varying discharge rates. Two common sequences have been identified; the first is the multi-storey, generally coarsening-up, lithofacies A; the second consists of thin sandstones, which grade into lithofacies B, which in turn grade into lithofacies A. The latter is characterized by gradational, coarsening-upwards sediments that are texturally mature towards the top. The cross-stratified and planar-bedded facies in any given sequence were deposited in the same reach of the river, and are interpreted as the subaqueous and emergent parts of a single bar. The facies association reflects the migration of the bar head and bar tail gravels across the bar pools. The better-organized beds are found lower in the sequence and were winnowed over long periods of time. The gravels on the tops of the bars were only winnowed during floods, and so are poorly sorted (Steel and Thompson, 1983).

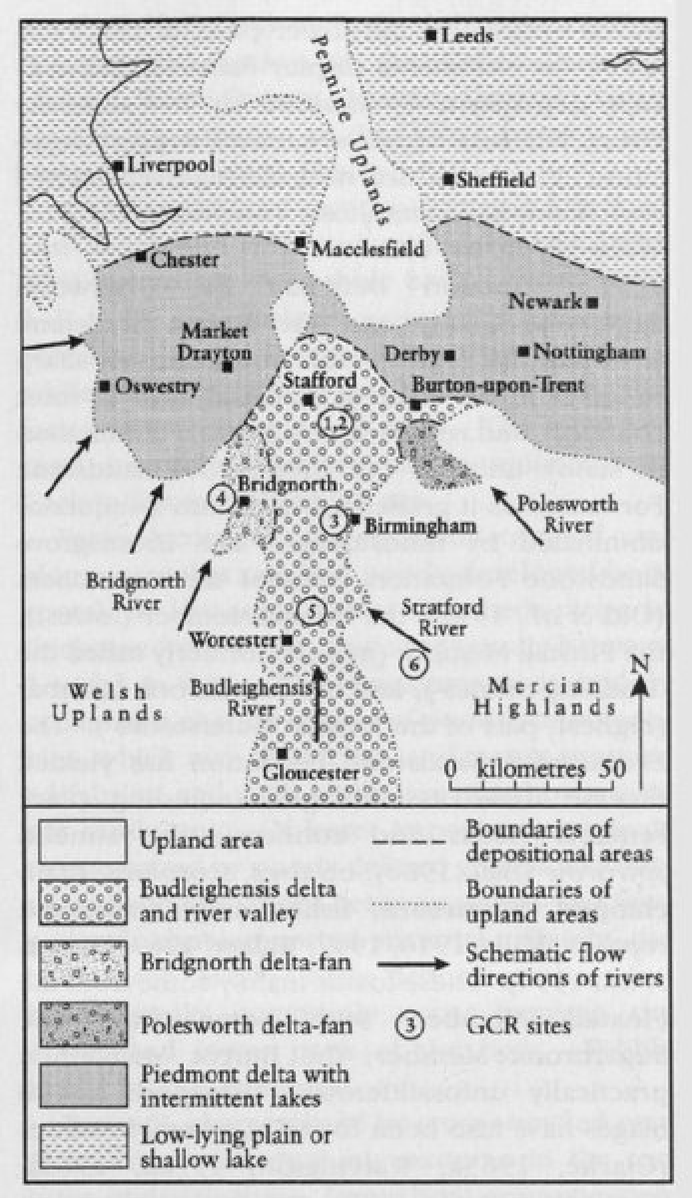
Conclusions

The Hulme quarries expose excellent sections through pebble beds in the Cannock Chase Formation. The sediments include structures such as planar and trough cross-bedding, re-activation surfaces, erosion surfaces and soft sediment deformation features. This is a superb site for the study of high-energy fluvial deposits of an ancient complex braided river system, and aspects of the palaeogeography of the Central Midlands area.

References



(Figure 3.51) Sedimentary log recorded in the Hulme quarries, showing the five lithofacies in the succession of the Cannock Chase Formation. (After Steel and Thompson, 1983.)



(Figure 3.50) Early Triassic palaeogeography of Central England, showing postulated major river systems, based on palaeocurrent measurements and studies of clast provenance. 1, Hulme Quarry; 2. Brockton Quarry; 3, Wollaston Ridge; 4, Claverley Road Cutting; 5, Burcot; 6, Shrewley (After Wills, 1948.)