Long Batch–Jonathan's Hollow

[SO 445 961]

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Introduction

The steep spur that lies between Jonathan's Hollow and Long Batch is the type section of the Batch Volcanic Beds, a series of tuff horizons that lie within the upper part of the Synalds Formation. This well-exposed section (Figure 5.13) has been selected as a GCR site as it reveals an almost complete sequence through the upper part of the formation and the lower part of the overlying Lightspout Formation, the tuffs providing an important series of correlateable marker horizons within the eastern Longmyndian. The volcanic origin of the tuffs was realized by Murchison (1867), but it was Cobbold (1900) who first named and described these beds. Although many authors have subsequently commented on the tuff horizons (James, 1956; Taylor, 1958; Toghill and Schell, 1984), they have never been formally designated, and the term 'Batch Volcanic Beds' remains in informal usage.

It was Greig *et al.* (1968) who gave their first detailed petrographical descriptions and suggested that they represent a final phase of Uriconian volcanic activity. Until recently, however, little was known of the detailed geochemistry of the tuffs, or their exact relationship to the earlier Uriconian volcanism.

Description

The section at Long Batch exposes steeply westward dipping strata, comprising about 150 m of the upper part of the Synalds Formation and the lower 100 m of the overlying Lightspout Formation. The Synalds Formation is typical of that exposed elsewhere on the Long Mynd, namely a succession of alternating purplish red-brown siltstones and mudstones with subordinate thinly bedded purplish grey sandstones. The sandstones are generally lithic arenites with a significant volcanic component, and some appear to be largely composed of tuffaceous material. Up to four horizons of acid to intermediate tuff are interbedded with the strata in the upper part of the formation in this area, but only two have been traced for any distance laterally (Greig *et al.,* 1968).

The lowermost tuff bed has been informally termed the 'Andesitic Ash' (Cobbold, 1900; Greig *et al.,* 1968). It is a generally massive, poorly sorted, coarse-grained, crystal lithic tuff, about 5 m thick with a sharp base and top, passing in places into a lithic-lapilli tuff (classification of Le Maitre *et al.,* 1989). It is well exposed on the lower part of the spur dividing Long Batch and Jonathan's Hollow (Figure 5.14) and on the valley slopes to the north-east ((Figure 5.13), Locality la). The tuff is characteristically greenish grey in its lower part, grading to pale purplish red higher up, and contains pyroclasts of large feldspar phenocrysts together with many conspicuous dark green epidotic aggregates, vis ible in hand specimen and locally up to 5 mm diameter. The latter display alteration rims of chlorite and white mica, commonly aligned within the rough cleavage that transects the tuff. The lower part of the tuff is noticeably coarser grained in places and, in addition, contains clasts up to 10 mm diameter of intermediate or basic volcanic rocks, reddened siltstone and mudstone.

About 45 m of mainly well-cleaved mudstones with thin sandstones separate the 'Andesitic Ash' from the next higher volcanic bed (Locality 2), an unnamed greenish grey, fine-grained tuff, up to 5 m thick, which crops out sporadically over the Long Mynd (Greig *et al.,* 1968). Up to 12 m of mudstone separate this horizon from the overlying 'White Ash' (Cobbold, 1900; Greig *et al.,* 1968). This is a distinctive, sharply defined bed of pale grey, white-weathering, coarsely feldspathic, crystal-lithic ash or lapilli tuff of intermediate composition, which contains many small elongate epidotic aggregates and conspicuous feldspar phenocrysts. There is, in places, a crude alignment of the feldspar laths and some of the epidote aggregates, suggestive of layering or grading. The tuff, which is 2–3 m thick in this area, crops out in the higher crags of the spur between Long Batch and Jonathan's Hollow (Locality 3), and can be traced into the adjoining valleys. It is overlain by up to 40 m of purplish red mudstones and thin sandstones before the highest representative of

the Batch Volcanic Beds supervenes. This is an unnamed pale grey and purplish red, fine-grained tuff, about 2 m thick, outcropping on the north-eastern slopes of Long Batch (Locality 4, 4a).

In thin section, there is little petrological difference between the various tuff horizons of the Batch Volcanic Beds. The matrix of the tuffs is composed mainly of micaceous aggregates, epidote and chlorite, which define a rough cleavage within the groundmass of the rock. The most abundant pyroclasts are albite or sodic oligoclase feldspar phenocrysts, occurring as stubby subhedral prisms or irregular fragments up to 1 mm across, in part altered to white mica, chlorite and epidote. Quartz also occurs, but is less abundant than feldspar and the fragments are usually smaller. Subordinate pyroclastic constituents include altered greenish brown biotite and, very rarely, prisms of apatite. Finely crystalline aggregates of chlorite, quartz and feldspar, some of which enclose small prisms of plagioclase, probably represent the alteration products of rhyolitic or andesitic fragments. The larger sericite-chlorite-epidote aggregates possibly represent reworked tuffaceous material (Greig *et al.,* 1968) . Sedimentary lithoclasts include reddened siltstone and mudstone, presumably from the Synalds Formation, as well as small sandstone pebbles; metamorphic quartzite has also been reported (Greig *et al.,* 1968).

The base of the Lightspout Formation occurs about 20 m above the highest tuff bed, on the spur between Jonathan's Hollow and Long Batch, the intervening strata of purplish red mudstone and siltstone representing the highest beds of the Synalds Formation. The Lightspout Formation is comparable to strata in its type area at the Lightspout Hollow GCR site. It typically comprises alternations of greenish grey siltstones with subordinate red beds and packets of thinly to thickly bedded sandstone. One of these packets, vertically disposed on the slope below Jonathan's Rock (Locality 5), consists of alternating bundles of thick (0.3 m) and thin (20–30 mm), fine- to medium-grained sandstone and subordinate laminated siltstone beds. A massive 4 m-thick bed of medium- to coarse-grained sandstone within this packet forms Jonathan's Rock. It possibly correlates with the Haddon Hill Grit (Whittard *et at,* 1953; James, 1956) or a similar sandstone in the lower part of the formation in the Carding Mill Valley, as seen at the Lightspout Hollow GCR site.

Interpretation

The strata of the Synalds and Lightspout formations are comparable to those that crop out around the Carding Mill Valley. They illustrate the fluvial processes that took place on the extensive alluvial floodplain that developed during the early Longmyndian. Their deposition followed a period of marine and fluvio-deltaic sedimentation, reflected in the underlying formations of the Stretton Group (Pauley, 1990a,b, 1991), and was part of a gradual shallowing, upwards-coarsening and progradation of facies that occurred throughout the eastern Longmyndian sequence. The composition of the large quantities of volcanic detritus within these sediments suggests that they were derived from sources largely within the Uriconian Group (Lapworth and Watts, 1910; Greig *et al.,* 1968; Pauley, 1990b).

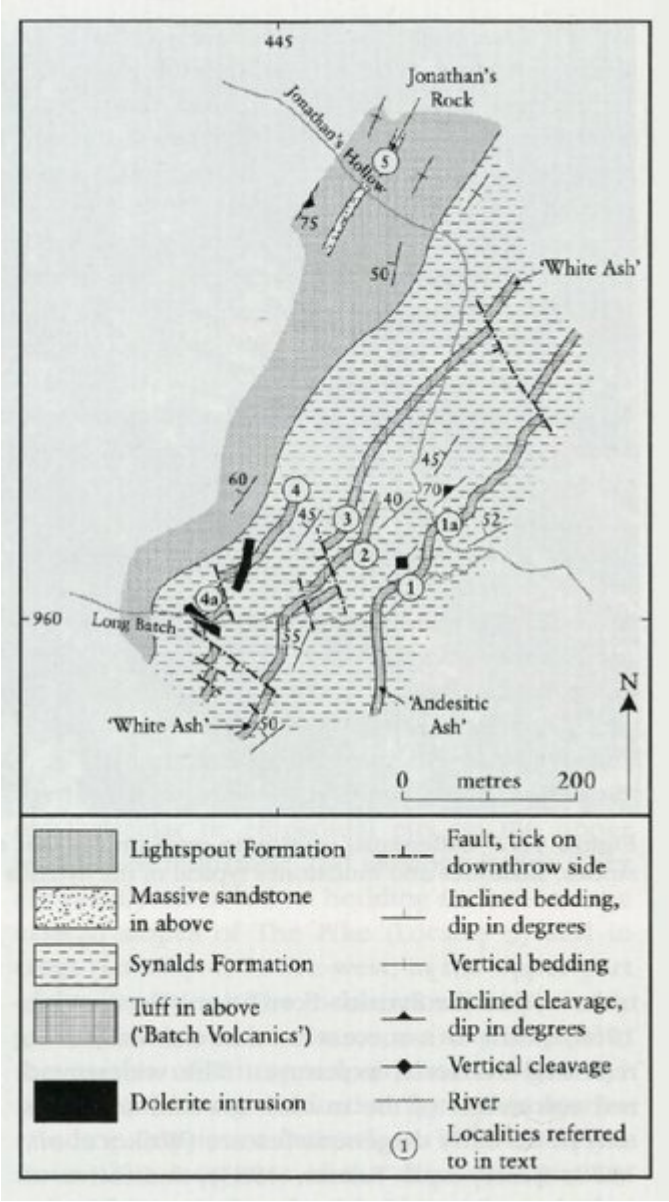
It has been suggested that the Longmyndian sediments were deposited in a nearshore setting, within a fore-arc basin to a Uriconian volcanic arc with an axis situated to the south or south-east (Thorpe *et al.,* 1984; Pauley, 1990a). The long-standing idea that sedimentation was partly coeval with Uriconian igneous activity (Cobbold and Whittard, 1935; Greig *et al.,* 1968; Pauley, 1990b) has been largely reinforced by the presence of pyroclastic litholigies within the Longmyndian succession, including the Batch Volcanic Beds seen here. Baker (1973), however, did not consider the need for such a direct link, preferring a later, extensional fault-controlled period of mild volcanicity to explain the presence of the tuff beds.

The Batch Volcanic Beds show no textural evidence for welding. In some places the lowest tuff (the 'Andesitic Ash') reveals a concentration of coarser lithic material towards the base, which could be interpreted as density grading within a pyroclastic flow unit. The alignment of elongate pyroclasts within the tuffs is a possible indicator of laminar flow (Williams and McBirney, 1979), but there has undoubtedly been overprinting of this fabric by subsequent deformation. The tuff beds may each record an individual ash-fall event, although from their poor sorting, coarse grain size and bedding characteristics they may be alternatively regarded as a series of single-event, subaerial pyroclastic ash-flows possibly deposited at some distance from the seat of the eruption. All of the Batch Volcanics were erupted across the alluvial floodplain sediments of the Synalds Formation, a depositional environment that has undoubtedly contributed towards the preservation of the tuff beds.

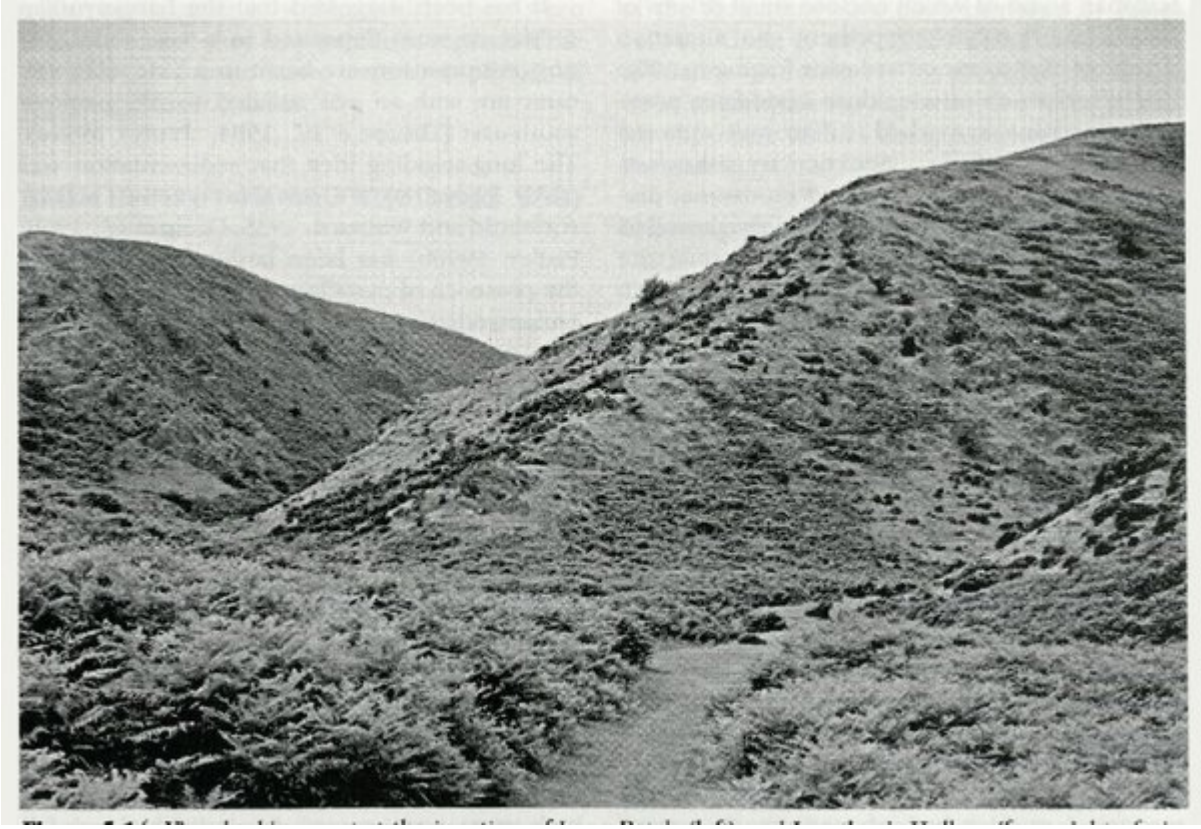
Conclusions

Long Batch and Jonathan's Hollow contain many informative sections through the upper part of the Longmyndian Synalds Formation and lower part of the Lightspout Formation. In particular, they provide the most complete sequence through the Batch Volcanic Beds, a group of intermediate ash and lapilli tuffs, which have been considered as late stage eruptions from the Uriconian Group. Evidence suggests that the tuffs were deposited subaerially, either as ash-fall deposits or distal pyroclastic flows in which welding fabrics were not developed. Their preservation may have occurred in areas that fortuitously escaped reworking in the alluvial flood-plain environments within which they were deposited, and they may therefore represent the remains of a once more extensive period of Longmyndian volcanism.

References



(Figure 5.13) Geological map of the Long Batch Jonathan's Hollow site.



(Figure 5.14) View looking west at the junction of Long Batch (left) and Jonathan's Hollow (from right of picture). Crags at base of spur are formed by the Andesitic Ash crossing from right to left across the spur. (Photo: A9425, reproduced by kind permission of the Director, British Geological Survey, © NERC.)