Tipalt Burn, Northumberland

[NY 687 683]–[NY 659 661]

Introduction

The Tipalt Burn GCR site is a 3.5 km-long stream section located just north of the A69 near Greenhead, about 9 km ENE of Brampton. More than 200 m of latest Asbian and Brigantian age strata are exposed, including the uppermost Lower Liddesdale Group [NY 687 683] and the Upper Liddesdale Group between the Low Tipalt Limestone and Bath-House Wood Limestone [NY 659 661] (Trotter and Hollingworth, 1932; Johnson, 1959; Day, 1970; Frost and Holliday, 1980). Trotter and Hollingworth (1932) and Johnson (1959) provided detailed accounts of the geology of the area including Tipalt Burn and, unless otherwise noted, the details below are based on their work. They included the strata exposed in Tipalt Burn within the Lower Limestone Group and Middle Limestone Group, but Day (1970) cast doubt on the value of perpetuating this stratigraphical scheme and assigned the beds to the Liddesdale Group. This practice is followed here, with limestone members identified as shown in (Figure 3.18). Spore and (1971) and Lees (1991). The Tipalt Burn trace-fossil assemblages from the section are succession provides several good exposures of respectively recorded by Marshall and Williams the richly fossiliferous Low Tipalt Limestone and an overlying sequence that exhibits one of the finest examples of Yoredale-style, delta–marine cyclicity in the Lower Carboniferous succession of northern England.

Description

A log of the Tipalt Burn succession is illustrated in (Figure 3.18). Across the site the exposed beds dip gently (12°–20°) to the south, with only minor disruption caused by three small faults. At the northern end of the site the uppermost part the Lower Liddesdale Group comprises an alternating and intermittently exposed sequence (35 m) of sandstone, shale and limestone. Day's (1970) record of Asbian gigantoproductids (*Gigantoproductus maximus* group) and the Brigantian coral *Lonsdaleia duplicata* in these beds reflects the transitional nature of this part of the succession which lies close to the level of the Asbian–Brigantian boundary.

Overlying these beds is the fossiliferous Low Tipalt Limestone (16 m), marking the base of the Upper Liddesdale Group (Figure 3.18). The rich fauna reported from this horizon by Johnson (1959) is dominated by rugose and tabulate corals (some in growth position) and brachiopods, but also contains bryozoans, heterocorals, bivalves and rare molluscs. The fauna includes *Diphyphyllum fasciculatum, Dibunophyllum, Koninckophyllum* spp., *Lithostrotion maccoyanum, L. clavaticum, Siphonophyllia benburbensis, Siphondendron* spp., *Megachonetes* (of the *papillionacea* group), *Cleiothyrtdina royssii, Eomarginifera* spp., *Overtonia fimbriata, Phricodothyris paricosta, Rhipidomella michelini* and *Schellwienella crenistria* together with numerous other productoids, spiriferoids and gigantoproductids (of the *giganteus* and *latissimus* groups). The most notable Brigantian taxa recorded are *Gigantoproductus gigantoides* and *Koninckophyllum* cf. *proprium* (see Johnson, 1959, for more details).

Above the Low Tipalt Limestone, 5 m of sandy shale and alternating flaggy sandstone and sandy shale are overlain by 5 m of flaggy, massive and rootleted sandstone beds (Day, 1970). Petrographical analysis of this sandstone and several others from the Tipalt Burn section has revealed a heavy-mineral suite of tourmaline, zircon, rutile and anatase, and, in some beds, traces of glauconite (Harrison in Day, 1970). The Lower Bankhouses Limestone comprises 75 cm of limestone, 1.2 m of calcareous shale and 1.8 m of limestone (Day, 1970). This is overlain by a thick shale sequence (*c.* 4 m), fossiliferous and marine in its lower part, with a goniatite-bearing pyritic shale towards the middle. Above this sequence lies the thinner Upper Bankhouses Limestone, in turn overlain by 6 m of shale, followed by more than 14 m of erosive-based, massively bedded, medium-grained, brown and yellow sandstone.

The Greengate Well Limestone comprises two 4.5 m limestone beds separated by 1.5 m of calcareous shale. The limestone contains *Siphonodendron junceum* and gigantoproductids. Above this lie shales (not exposed in Tipalt Burn) and sandstones with flaggy partings; the latter were almost certainly used in the construction of Hadrian's Wall.

The Oxford Limestone (5 m) contains crinoid remains and a coral–brachiopod fauna that includes *Lingula.* The overlying calcareous shale is packed with skeletal debris and coarse crinoid debris. This grades upwards into a fossiliferous dark mudstone, which is capped by a ferruginous shale and about 6 m of thin-bedded and flaggy sandstones with numerous trackway markings, possibly made by annelids.

The Barrasford Limestone (6 m) is a dark, skeletal and partly dolomitized limestone with shale partings. A coral–brachiopod fauna dominates this interval, but the unit also contains 'algal' nodules of the form genus *Osagla* and the foraminiferan *Saccaminopsis fusulinaformis.* Above this is a 30 m-thick sequence of shale, sandstones and a 20 cm-thick coal (Figure 3.18). A buff-coloured calcareous sandstone grades upwards into the sandy and dolomitic base of the Colwell Limestone which contains a coral–brachiopod fauna more typical of the Brigantian Stage, including *Actinocyathus floriformis, Siphonodendron junceum, G. giganteus, R. michelini, Eomarginifera* cf. *longispina,* as well as the demosponge *Chaetetes.* The overlying shale and sandstone are also well exposed in Tipalt Bum. Trotter and Hollingworth (1932) reported a 20–45 cm coal immediately beneath the Colwell Limestone, but comparison of vertical sections (Trotter and Hollingworth, 1932, fig. 7; Johnson, 1959, fig. 8) suggests that this coal lies beneath the 'Cockleshell' Limestone. The 'Cockleshell' Limestone is a thin (< 2 m), fairly fossiliferous dark-grey skeletal limestone. However, because of its lateral variability and correlation difficulties, this limestone was not formally adopted as a named unit by Frost and Holliday (1980). The overlying slliciclastic sequence includes fine- to medium-grained lenticular sandstones, and, underlying the Bath-House Wood Limestone, a 12–20 cm-thick coal. An adit driven into the thick sandstone beneath the Bath-House Wood Limestone represents an unsuccessful attempt to find galena. The Bath-House Wood Limestone crops out at the southern limit of the site. This limestone is thicker than the 'Cockleshell' Limestone, but is otherwise similar In character. It is overlain by almost a metre of fireclay and a 5 cm-thick coal.

Interpretation

As is the case with other sections in the Northumberland Basin, problems of correlation have provided the focus for most of the work on the Tipalt Burn sequence. Trotter and Hollingworth (1932) correlated the Low Tipalt Limestone and Bankhouses Limestones with the Oxford Limestone to the north and the Smiddy Limestone to the south, but Johnson (1959) concluded that the Low Tipalt Limestone and Bankhouses Limestones must correlate with a lower horizon and suggested a Smiddy–Low Tipalt–Woodend correlation. Frost and Holliday (1980) correlated the Low Tipalt Limestone with the Peghorn Limestone to the south and the 'Spirifer Band' to the north-east (Figure 3.3) and (Figure 3.5). They correlated the Bankhouses Limestones with the lower part of the Smiddy Limestone to the south and the Watchlaw Limestone to the north-east (see Spittal Shore GCR site report, this chapter). Correlation of the Greengate Well Limestone with the Lower Little Limestone to the south was proposed by Trotter and Hollingworth (1932) and has been followed by subsequent authors (Johnson, 1959; Frost and Holiday, 1980; Johnson *et al*., 1995). The Greengate Well Limestone thins northwards (Figure 3.5) and has no lateral equivalent limestone in more northern and eastern parts of the Northumberland Trough (Johnson, 1959; Frost and Holliday, 1980), although Day (1970) proposed its correlation with the Penton Limestone of the Langholm district to the north-west (see Penton Linns GCR site report, this chapter). The correlation of the Oxford Limestone of the Northumberland Trough with the Jew Limestone of the Alston Block has been stable since originally proposed by Garwood (1910). The Barrasford Limestone was described as the 'Tyne Bottom Limestone' by Trotter and Hollingworth (1932) and Johnson (1959), and correlated with the Tyne Bottom Limestone to the south. Frost and Holliday (1980), however, correlated the Barrasford Limestone with the upper part of the Jew Limestone to the south (Figure 3.5). To the north and east the Barrasford Limestone has no named lateral equivalent. Johnson (1959) described the Colwell Limestone as the 'Single Post Limestone' and correlated it with a unit of the same name to the south. He was unable to correlate it with a specific horizon to the north or east. Frost and Holiday (1980) correlated the Colwell Limestone with the Tyne Bottom Limestone to the south and the Budle Limestone of north-east Northumberland (Figure 3.5). While Trotter and Hollingworth (1932) and Johnson (1959) regarded the Bath-House Wood Limestone as the correlative of the Scar Limestone, Frost and Holliday (1980) equated it with the Single Post Limestone farther south. No named lateral equivalent has been identified to the north or east. Johnson *et al.* (1995) follow Frost and Holliday's (1980) correlations of the Greengate Well Limestone and Oxford Limestone, but not those proposed for the higher units or for the correlation of the Low Tipalt Limestone with the 'Spirifer Band' in north Northumberland.

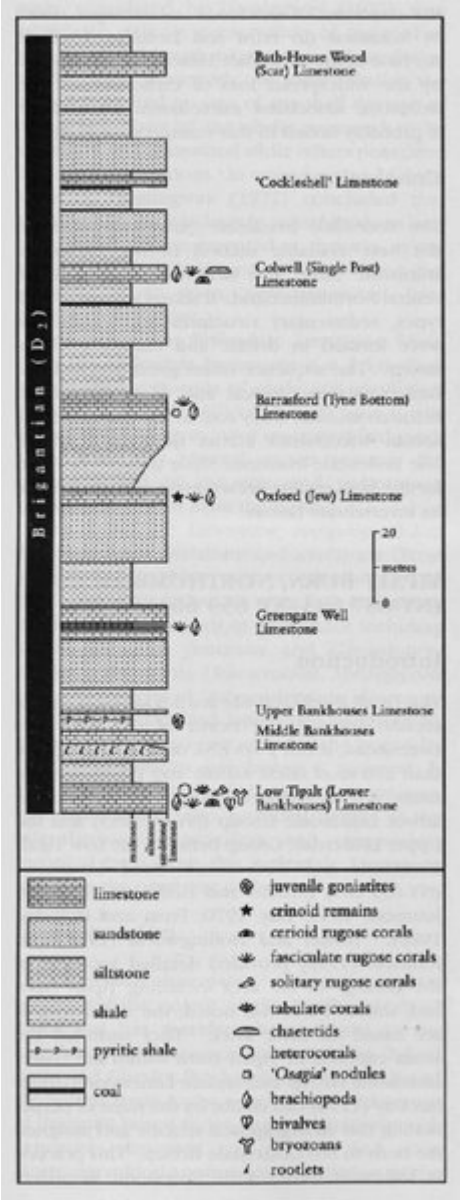
As noted by Frost and Holliday (1980), subdivision and correlation of the Carboniferous sequence exposed in Tipalt Burn and the surrounding area has been based on the establishment of marker beds with supposed or established palaeontological significance. Some of the problems of correlation noted above have arisen because of this conflation of biostratigraphy and lithostratigraphy. The Upper Liddesdale Group corresponds to the D_2 coral–brachiopod zone (Johnson, 1959; Day, 1970), or the Brigantian Stage of the current chronostratigraphical scheme (George *et al.,* 1976; see (Figure 3.3)). The base of the Brigantian Stage is defined at the base of the Peghorn Limestone near Kirkby Stephen to the south (George *et al.,* 1976; *see* Janny Wood GCR site report, Chapter 5) and, consequently, the correlation of this horizon with the Low Tipalt Limestone in Tipalt Burn is important in establishing the Low Tipalt Limestone as the marker horizon for the base of the Brigantian Stage in the Northumberland Trough (Figure 3.3) and (Figure 3.5).

The Tipalt Burn succession provides an outstanding example of the interdigitation between marine and deltaic deposits so typical of the Yoredale style of cyclicity found throughout northern England. However, since the site has received little attention from modern researchers, only general comments on its sedimentological significance are outlined in this account. Clastic facies probably represent deposition in river-dominated deltaic settings, with pro-delta mudrocks, mouth-bar coarsening-upward sand-bodies, bay-levee-crevasse sequences, distributary channel sandstones and lacustrine backswamp mudrocks (Leeder *et al.,* 1989). Palaeocurrent data from distributary channel sand-bodies indicate a south-westerly palaeoflow (Leeder *et al.,* 1989). Thin, laterally persistent coals represent periods of delta-lobe abandonment, often followed by subsidence, the re-establishment of marine conditions and the deposition of fossiliferous limestones and shales (Elliott, 1974a, 1975). Johnson (1959) interpreted a dome-like structure in the Low Tipalt Limestone as evidence that knoll reefs were developed at the top of the unit. However, Day (1970) interpreted the doming as a tectonic feature and it seems unlikely that true knoll reefs occur here.

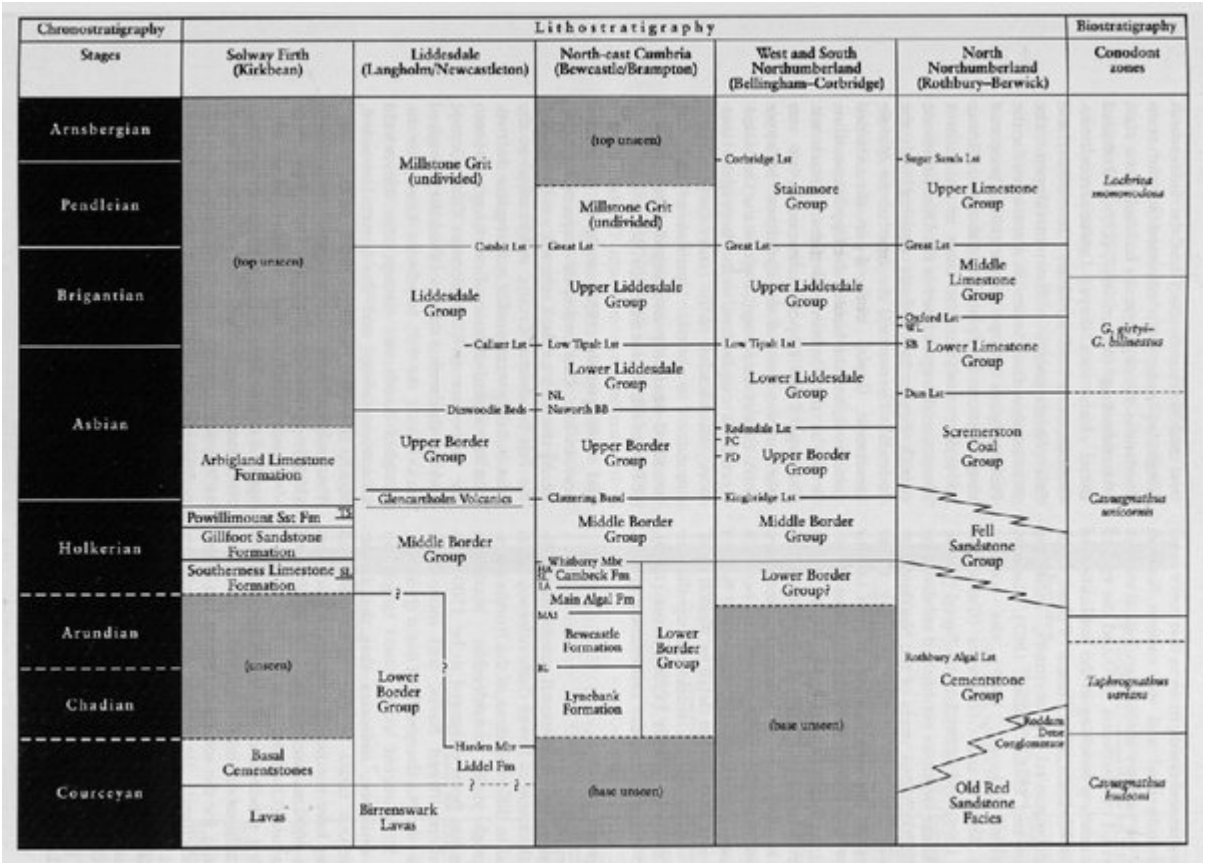
Conclusions

The Tipalt Burn GCR site provides arguably the best section for the examination of upper Viséan Yoredale cyclothems in the southern part of the Northumberland Basin. The exposure extends through several carbonate–clastic depositional cycles formed by alternating marine and fluvio-deltaic processes, resulting in the formation of a number of named lithostratigraphical units (especially limestones) of the Liddesdale Group which are among the finest developments of their kind in the region. The sequence as a whole, and the Low Tipalt Limestone in particular, has great potential in future sedimentological, palaeoecological and palaeontological investigations. The Low Tipalt Limestone has been central in establishing local lithostratigraphical subdivisions and in regional correlations of the Brigantian Stage across the Northumberland Trough and onto the adjoining Alston Block.

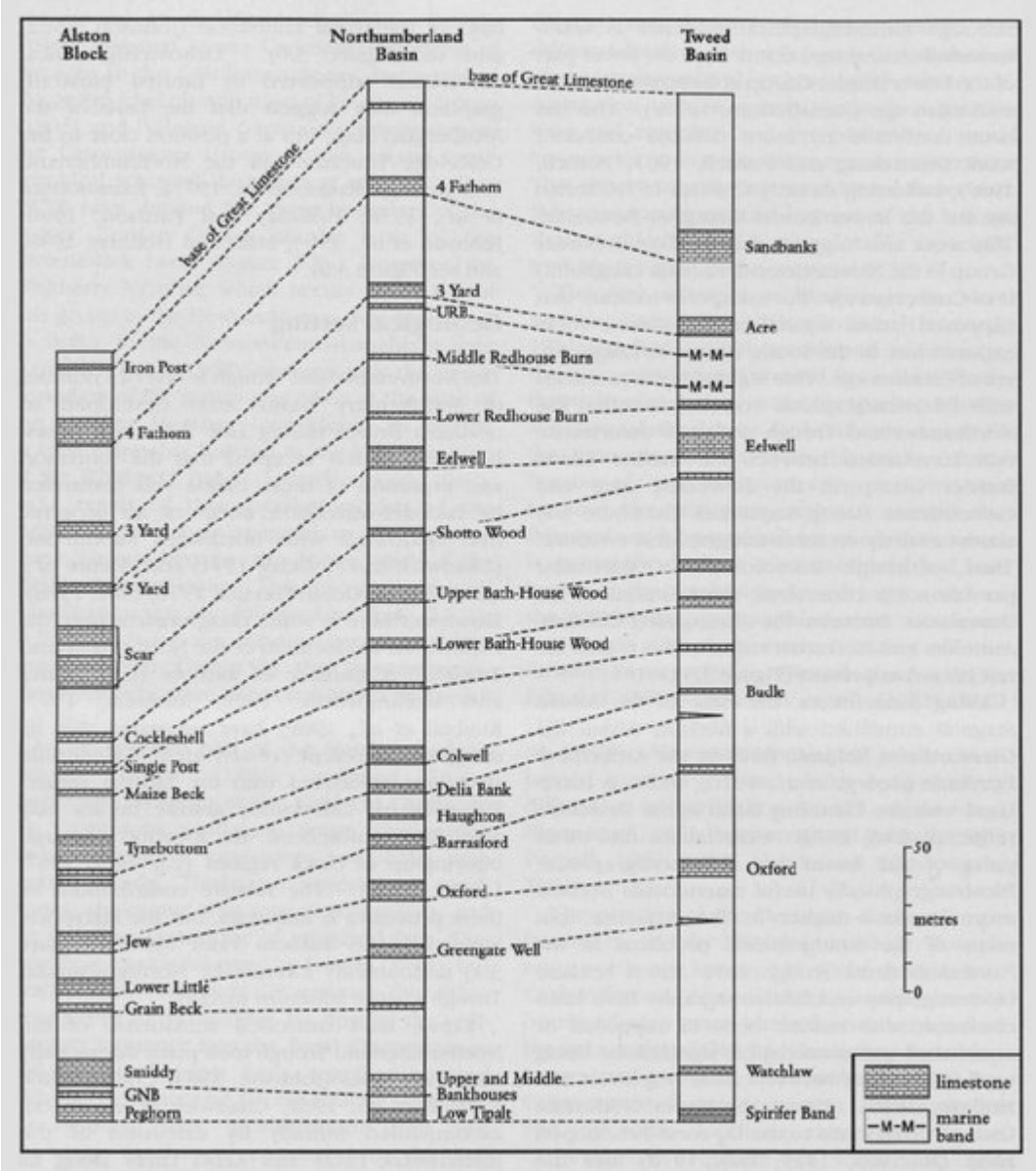
References



(Figure 3.18) Section of the Upper Liddesdale Group (Brigantian) succession in Tipalt Burn. After information in Johnson (1959). Limestone names follow the nomenclature used by Day (1970) and Frost and Holliday (1980), while the names in parentheses are those used by Trotter and Hollingworth (1932) and Johnson (1959). See text for discussion of the problems associated with the naming and correlation of these limestone marker beds.



(Figure 3.3) Simplified Lower Carboniferous stratigraphical chart of the Northumberland Trough. Compilation based on information from Lumsden et al. (1967), Day (1970), George et al. (1976), Ramsbottom et al. (1978), Frost and Holliday (1980), Armstrong and Purnell (1987), Smith and Holliday (1991), Purnell (1992), British Geological Survey (1993a), Turner et al. (1993), Chadwick et al. (1995), Johnson et al. (1995) and Maguire et al. (1996). Note that the implied correlations between the lithostratigraphy and both the biostratigraphy and the chronostratigraphy remains uncertain in many areas. SL — Syringothyris Limestone Member; TS — Thirlstane Sandstone Member; BL — Bogside Limestone Member; MAI — Main Algal 1 Member; LA — Lower Antiquatonia Member; HA — Hillend Algal Member; Naworth BB — Naworth Bryozoa Band; NL — Naworth Limestone; PD — Plashetts Dun Limestone; PC — Piper's Cross Limestone; SB — Spirifer Band; WL — Watchlaw Limestone; Lst — Limestone; SSt — Sandstone; Mbr — Member; Fm — Formation. Conodont zones from Armstrong and Purnell (1987) and Purnell (1989, 1992). Not to scale.



(Figure 3.5) Stratigraphy of the Upper Liddesdale Group (Brigantian, D_2) limestones from the Alston Block to the Northumberland Basin and the Tweed Basin. (GNB — Girvanella Nodular Bed; URB — Upper Redhouse Burn.) After Frost and Holiday (1980).