
Wasdale Beck, Cumbria

[NY 578 095]

Introduction

The Wasdale Beck GCR site is a stream section, lying 7 km north-west of Tebay and some 150 m south-west of the Shap Wells Hotel [NY 578 095]. It is a critical site for the examination of the unconformity between the fluvial Shap Conglomerate (Garwood, 1913) of Lower Carboniferous (Courceyan) age and the marine Brathay Flags of Silurian (Wenlock) age. The locality is particularly important on account of the unusually high concentration of igneous material found in the Shap Conglomerate; material that was locally derived from the weathering of Borrowdale Volcanic and the Shap Granite outcrops at the beginning of the Carboniferous Period. Early reference to the section is made by Aveline and Hughes (1888) and Garwood (1913), but the most useful accounts that relate specifically to the Shap Conglomerate are provided by Capewell (1955) and Kimber and Johnson (1986).

Description

The Brathay Flags are best exposed at a prominent waterfall at the south-western end of the site. Here the unit comprises dark, pyritic and laminated siltstones, dips steeply to the southeast and has a distinctive Caledonide (northeast-south-west) trend (Shipp, 1992). Northwards (downstream) the unit is unconformably overlain by the gently dipping beds of the Shap Conglomerate (= the 'Basement Series' of Capewell, 1955), which are best exposed in small cliff sections on the right bank of the beck as it approaches the Shap Wells Hotel. The two units are separated by an irregular unconformity surface (Aveline and Hughes, 1888).

Above the unconformity the Shap Conglomerate comprises a heterogeneous mix (< 10 m thick) of vari-coloured (reddish-brown to green) clastic sedimentary rocks dominated by conglomerate, but with minor developments of sandstone, siltstone and mudstone. This part of the succession was referred to by Capewell (1955) as the 'Lower Conglomerate Group', the lowest of three subdivisions he recognized in the Shap Conglomerate. Capewell (1955) described these basal conglomerates as having angular casts of up to cobble size set in a sandy and sometimes dolomitic matrix. He also recognized temporal changes in the composition of the conglomerates, with Silurian rock fragments at the base of the sequence being successively replaced as a major constituent up sequence, first by the cleavage fragments of pink orthoclase crystals derived from the Shap Granite and Shap Granite pebbles (especially in a prominent conglomerate unit currently well exposed 0.5–3 m above the unconformity surface), then by silicified clasts of Borrowdale Volcanic origin.

While recognizing the occurrence of locally derived debris from the Shap Granite, a more rigorous provenance study of the Shap Conglomerate by Kimber and Johnson (1986) confirmed the overwhelming dominance (92%) of highly altered acidic volcanic debris (including clasts of devitrified rhyodacite, spherulitic rhyolite and ignimbrite with minette) derived from the Borrowdale Volcanic Group. Palaeocurrent work here by the same authors favoured a south-westerly to SSW provenance for this material.

Interpretation

The angular unconformity between the Brathay Flags and the Shap Conglomerate formed at the end of Early Palaeozoic times during the Caledonian orogenic episode when much of northern Britain was transformed into a mountainous land area. During this orogenic episode, which began in the late Silurian Period and continued into the Devonian Period, the Lower Palaeozoic rocks of the Lake District (including the Brathay Flags) were deformed, metamorphosed and uplifted within an emerging landmass that was subsequently intruded by granites (e.g. the Shap Granite) and exposed to the effects of subaerial weathering. The Shap Conglomerate formed as an erosional by-product of this weathering process at the beginning of the Carboniferous Period, and the inclusion within it of material derived from the Shap Granite (early

Devonian) bears testimony to the unroofing of this granite at this time (see Shilston and Harpum, 1964; Taylor *et al.*, 1971; Shipp, 1992).

The Shap Conglomerate formed as a post-orogenic subaerial piedmont fan complex that developed on the eastern margin of the Lake District massif between Ullswater and Ravenstonedale during early Dinantian times (Capewell, 1955; Ashton, 1970; Johnson and Marshall, 1971). Although basal to the Carboniferous succession at Wasdale Beck, a similar continental red-bed facies mapped as Shap Conglomerate overlies the earliest Carboniferous deposits of the Pinsky Gill Beds at Ravenstonedale to the south (see (Figure 5.3) and Pinsky Gill GCR site report, this chapter). However, Capewell (1955) considered the conglomerates at Wasdale Beck as the direct lateral equivalents of the Pinsky Gill Beds (which are dated as Courcayan in age on miospore and conodont evidence; see Johnson and Marshall, 1971; Holliday *et al.*, 1979; Varker and Higgins, 1979; and Pinsky Gill GCR site report) and older than the Shap Conglomerate of the Ravenstonedale area.

Regional variations in sequence thickness and the presence of early diagenetic cements led Capewell (1955) to conclude that the conglomerates at Wasdale Beck were alluvial-fan deposits that formed in an erosional hollow in the underlying Silurian bedrock and, possibly subaqueously, in the same 'saline body of water' (lagoon?) as the Pinsky Gill Beds. A depositional setting for the Shap Conglomerate close to the margin of the Stainmore Basin was envisaged by Barraclough (1983). A more refined view was taken by Lumber and Johnson (1986) who considered the Shap Conglomerate as the product of an early Carboniferous valley-confined braided river system that flowed to the north or NNE draining an elevated landmass of considerable topographical expression (the Lake District massif) which may have been densely vegetated.

Conclusions

The unconformity between the marine Brathay Flags of Silurian age and the fluvial Shap Conglomerate of Lower Carboniferous age reveals important evidence of a significant mountain-building episode (the Caledonian Orogeny) which took place at the end of the Silurian Period. Its association with the overlying fluvial Shap Conglomerate provides critical evidence of the unroofing of the Shap Granite during early Carboniferous times. Together these features make Wasdale Beck an outstanding site for educational purposes and in particular for the understanding of basic geological principles.

[References](#)

Chronostratigraphy	Biostratigraphy	Lithostratigraphy			
		Stainmore Basin (Ravenstonedale)	Askrigg Block		Transition Zone (between Askrigg Block and Craven Basin)
Stages	Zones		Northern and Central Area (including subsurface)	Southern Area	
Arsbergian		Mirk Fell Beds		(top unseen)	(top unseen)
Pendeian	(undivided)	Stainmore Group	Stainmore Group	Grassington Grit	Grassington Grit
				U. Bowland Shales Sugar Loaf Lst Sugar Loaf Shales	Upper Bowland Shale Formation
Brigantian	<i>Dibunophyllum</i>	Alston Group	Upper Alston Group	Wensleydale Group	Lower Bowland Shale Formation
			Peghorn Limestone Birdale Lst Robinson Lst		
Asbian		Lower Alston Group	Great Scar Limestone	Malham Formation	Pendleside Limestone Formation
Holkerian	<i>Productus corrugato-hemisphericus</i>	Orton Group	Ashfell Limestone	Cove Limestone Member	Scaleber Quarry Limestone Member
Arundian	<i>Michelinia grandis</i>	Orton Group	Ashfell Sandstone	Kilnsey Formation	Scaleber Force Limestone Member
Chadian	<i>Athyris glabristria</i>	Ravenstonedale Group	Penny Farm Gill Dolomite	Chapel House Limestone	Chapel House Limestone
Courceyan	(undivided)	Ravenstonedale Group	Marsett Sandstone Raydale Dolomite		Stockdale Farm Formation
					(base unseen)

(Figure 5.3) Simplified stratigraphical chart for the Lower Carboniferous sequence of the Askrigg Block and Stainmore Basin. Compilation based upon and modified after George et al. (1976), Dunham and Wilson (1985), Arthurton et al. (1988), British Geological Survey (1997b,c), and Mundy (2000). Zonal biostratigraphy (Chadian–Brigantian only) after Garwood (1913). For further details of the Wensleydale Group, Upper Alston Group and Stainmore Group successions, see (Figure 5.4). Areas of vertical ruling indicate non-sequences. Not to scale.