Jeffrey's Mount, Tebay

[NY 607 017]–[NY 610 026]

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Highlights

Clean, continuous roadside exposures here allow uninterrupted observations to be made on the D_1 folds in the Ludlow Series Coniston Grit Formation sandstones. These typify much of the structural style of the southern Lake District. Together with the Shap site, the locality permits a view of the larger-scale folds of the late-Caledonian deformation, produced during the Early Devonian, overprinted by numerous D_2 folds and fractures.

Introduction

This section is situated on the A685 about one mile south of Tebay village (Figure 3.16) and (Figure 3.19). It comprises the predominantly greywacke sequences of the Coniston Grit Formation. In this region, the Bannisdale Slate Formation and the Coniston Grit Formation were folded during the main Caledonian deformation (D_1) to form the major Bannisdale Syncline (F_1), and were affected by associated cleavage (S_1), minor folds (F_1) and faults.

The site shows many structural features similar to those seen at Shap Fell, but complements that site by its excellent exposures of structures on the opposing limb of the major, D_1 Bannisdale Syncline at a similar structural level. Further details on the general stratigraphy and structure of this area are given in the site description for Shap Fell. Mention of the site is made by Moseley (1972).

Description

At this section the Silurian Coniston Formation Grit consists of greywacke beds from 0.05 m-3 m thick, with subsidiary laminated greywackes, silt-stones and mudstones. There are nine minor folds present, all essentially concentric and with virtual zero plunge, but with complications where thicker mudstone units are involved. There are other complexities, which include small (~1 m wavelength) recumbent folds, low-angle shears, kink bands which deform the cleavage and high-angle wrench faults (Moseley, 1972, 1986). Cleavage is poorly developed.

Folds

The folds and the poorly developed, axial-plane cleavage are the product of early Devonian main phase (D_1) deformation. Local D_2 phase structures (Table 3.1) according to Soper *et al.* (1987) postdate the underlying Shap Granite (394 Ma BP). The faults belong to the subsequent north-east-trending wrench fractures, some of which pre-date the nearby Carboniferous succession. The folds (see (Figure 3.19)) are open and, being on the south-east limb of the synclinorium, there is a general younging of the sequence towards the north-west and vergence to the south-east. The preponderance of greywacke sandstone in both thick and thin beds, as well as resulting in an absence of cleavage, also results in an absence of minor structures, although fold 4 exhibits a recumbent buckle on its northern limb. This could represent the late-Caledonian recumbent fold phase (F_2), which has been noted elsewhere in descriptions of the Silurian of the Lake District (Moseley, 1972), but it is more likely to be a local reaction to irregular stress conditions. The stereogram (Figure 3.19, inset) summarizes the orientations of bedding and fold plunge.

Faults

The most prominent faults are near-vertical wrench faults, with north and north-west trends, the former sinistral and the latter dextral. The actual displacements of the faults cannot be determined from the section. Both fault sets, however, intersect the roadside section where they have resulted in thin shatter zones (up to 1 m wide). There are also

well-developed joints parallel to the faults. Small thrusts or 'thrust joints' are also fairly common (Figure 3.19), all inclined north, and generally with displacements of only a few centimetres.

Interpretation

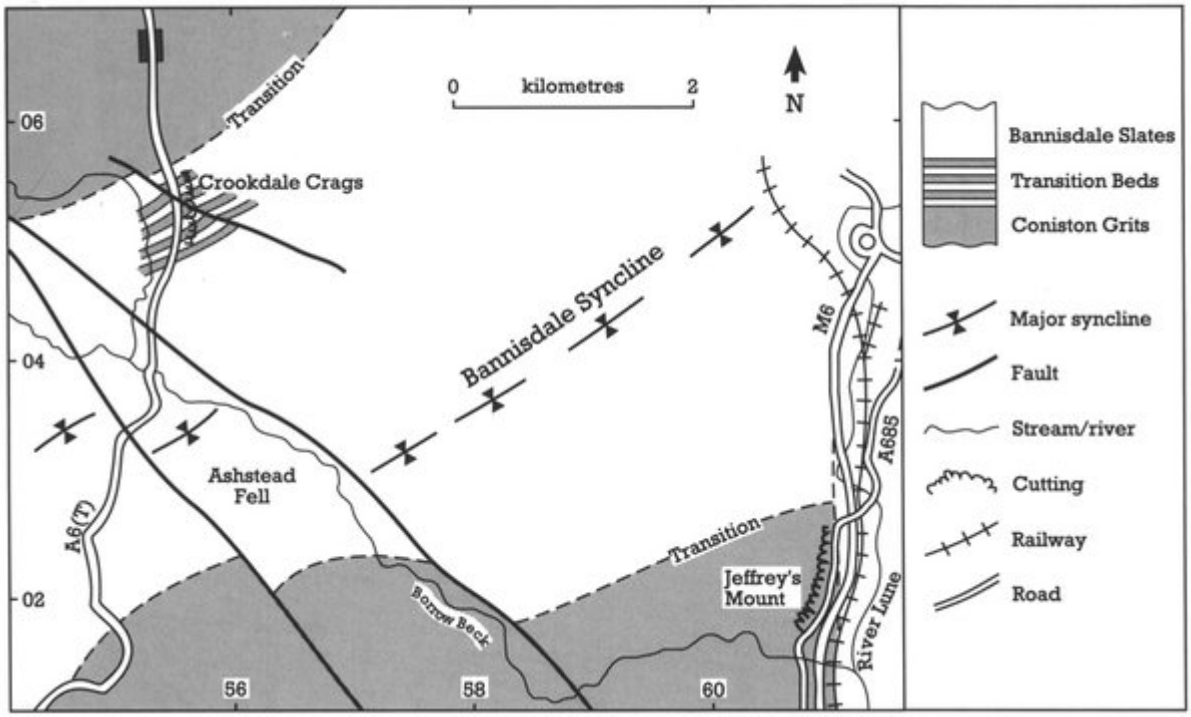
The structures at Tebay are a product of main phase, early Devonian deformations (D_1). Comparing them with those on the north-west limb of the Bannisdale Syncline at Shap Fell, it is evident that the folding is less intense here. This is attributed to the competence of the greywackes at Tebay compared with that of the mudstones of the A6 section, which also explains the poor cleavage development.

Since these exposures are at the same structural level as those at Shap Fell they provide an interesting contrast in fold style, in the context of variations in the multi-layer sequence and the development of cleavage. They also provide an opportunity to demonstrate the presence and geometry of a major D_1 fold, the Bannisdale Syncline, seen from the opposing vergence as well as from the calculation of sheet-dip and the demonstration of younging. Minor faults are particularly well seen here. Sections such as this, as well as that at Shap, have provided important data for the study of the late-Caledonian deformation and will do so in the future.

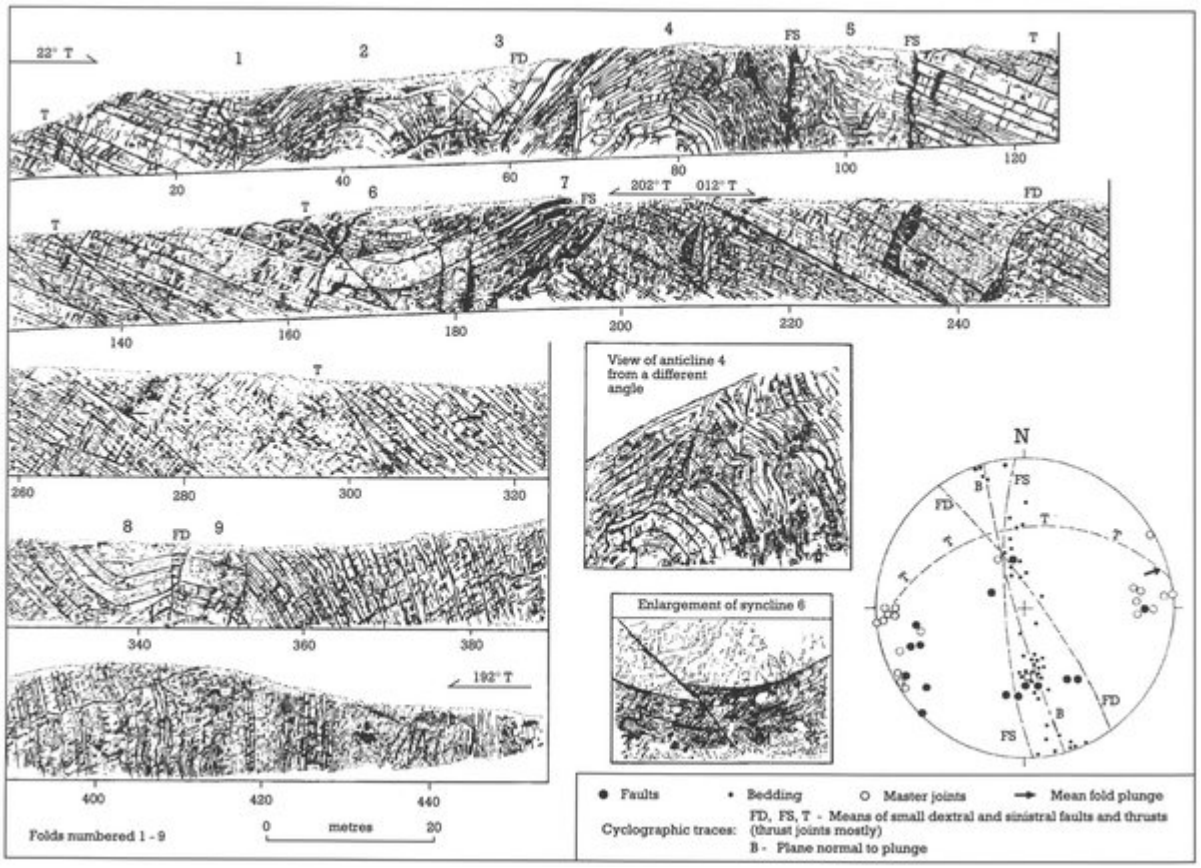
Conclusions

Jeffery's Mount provides an excellent cross-sectional view of the style of folding in the rocks of the Windermere Group (which are here of late Silurian age), when it is dominated by sandstones. It allows a comparison of the minor structures on the southeastern limb of one of the largest folds in the Lake District, the Bannisdale Syncline, as well as enabling the geometry and position of the major fold to be established. This major fold was the product of folding during the main Caledonian mountain building phase. Numerous later, flat folds, angular folds (kink bands), and low-angle fractures deform the main structures. These are known to be later than the granite intrusion at Shap, which is dated at 394 million years before the present, which gives an age to this final episode of Caledonian deformation.

References



(Figure 3.16) Geological map of the Bannisdale Syncline, showing positions of Crookdale Crags (see Fig. 3.17) and Jeffrey's Mount (after Moseley, 1986).



(Figure 3.19) Fold structure at Jeffrey's Mount, Tebay (after Moseley, 1972).

Stratigraphy and timing of events	Description of deformation phase	Phase numbering and contributions by various workers					
		Simpson (1967)	Soper (1970) and others (see text)	Moseley (1972)	Roberts (1977)	Webb and Cooper (1988)	This volume
	FAULTING dominantly N and NW trends						
	N-S FLEXURES with weak fracture cleavage				D_4		D_3
	RECLINED FOLDS with flat crenulation cleavage		D_2		D_3		D_2
Late Early Devonian intrusion of Shap (394Ma) and Skiddaw (399Ma) Granites							
MAIN END-CALEDONIAN PHASE: (Pridoli) WINDERMERE GROUP (Mid-Caradoc)	UPRIGHT FOLDS Major and minor, with transecting cleavage, trending NE to E	F_3	D_1	Phase 3 Related to collision	D_2	D_3	D_1
VOLCANO-TECTONIC FLEXURING AND TILTING							
(Early Caradoc) BORROWDALE VOLCANIC GROUP (Llandeilo)	Open E-W folding, block faulting		E-W folds large scale, no cleavage	Phase 2 Related to subduction and closure	Not recognised in Skiddaw Group	D_2	Volcano-tectonic deformation (Branney and Soper, 1988)
VOLCANO-TECTONIC UPLIFT BEGINS?	INITIATION OF ENE-TRENDING LAKE DISTRICT ANTICLINE?						
(Llanvirn) (Arenig) SKIDDAW GROUP (Tremadoc) ?	N-TRENDING FOLDS no cleavage	F_1 and F_2 (descriptions as D_1 and D_2 this volume)	N-S folds minor, no cleavage	Phase 1 N-S folds, minor in largely unconsolidated sediments	D_1 N-S folds, recumbent and minor, in largely unconsolidated sediments	D_1 N-S folds (but variable), large and small scale submarine slides and slumps	D_0 Large and small scale slumps as Webb and Cooper (1988), early small scale slumps

(Table 3.1) Deformation sequences in the Lake District as interpreted by various authors; the last column shows the system adopted in the present volume.