West Burrow Head

[NX 4518 3411]–[NX 4534 3411]

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Highlights

This site has total exposure across the stratigraphically and structurally important boundary between the Hawick Rocks and fossiliferous strata of the Lower Wenlock Series. The boundary here is clearly faulted, but the throw of the fault has been the subject of controversy.

Introduction

This coastal locality is important in the controversy concerning the nature of the junction between the belt of Wenlock rocks, in the south-east, and the Hawick Rocks, to their north (see Walton *in* Craig, 1983 p. 129). At Fouldbog Bay, the along-strike equivalent of this steeply dipping junction is claimed, by Craig and Walton (1959), to be marked by transitional beds from the younger Hawick Rocks south-eastwards to the Wenlock. They concluded (see also Clarkson *et al.,* 1975) that the Hawick Rocks must therefore have either a latest Wenlock or a Ludlow age. At Burrow Head, Rust (1965) claimed that transitional rocks were absent and that the junction exposed between the Hawick Rocks (assumed by him to be Upper Llandovery) and the Wenlock, was a fault which required a southward downthrow of some 3 000 m. Rust considered that the apparent transitional rocks (red mudstones associated with graptolitic Wenlock) might have been produced by fault slicing at Burrow Head, Fouldbog Bay and elsewhere.

Most recently, Kemp and White (1985) and Kemp (1986), working in the Fouldbog area and in areas further to the north-east, has claimed that the Wenlock strata south-east of the Hawick Rocks are an intensely imbricated sequence of packets successively younger in that direction; like Rust (1965), he has attributed a Late Llandovery age to the Hawick Rocks. Barnes *et al.* (1987, Figure 4) confirm Rust's (1965, Figure 4B) observation, and that of the present work, that the site lies on the short limb of a major SE-verging fold pair, with a wavelength of about 1 km. Barnes (1989) cites the graptolite evidence which firmly assigns the rocks here to the Llandovery.

Description

At the north-west end of the site (Figure 2.12)A and B, regularly bedded, south-east dipping, Hawick greywackes and siltstones young consistently upwards, interrupted rarely by fold pairs verging to the north-west. Two distinctive red mudstone beds occur near the top of the exposed succession (Figure 2.12)A. Some 20 m to the east of the red mudstones, a zone, about 10 m wide, is traversed by five steep fracture planes trending north-east (Figure 2.12)B. The fractures are not associated with any of the usual fault-plane features suggesting major movement, except possibly thin mylonitic banding. The slices between the fractures usually retain some coherence of bedding, although a 1 m-wide central slice contains strikingly lensoid beds of greywacke. One syncline and one anticline core are evident elsewhere in the slices. To the south of the fractures, the first coherent greywackes, again clearly young to the south-east, but are immediately involved in a tight syncline. The north-west-younging continues through beds containing graptolitic mudstones of Wenlock age (see Rust, 1965, Figure 2), but is reversed again to the south-east after 20 m by the complementary anticline. The Wenlock rocks continue to dip and young to the south-east for at least another 200 m towards Burrow Head, with rare interruption by north-west-verging fold pairs. (Figure 2.12)A & B

Interpretation

This site demonstrates that the junction between the Wenlock and Hawick Rocks, at least locally, is a fault zone. Apart from the physical evidence of fracture planes separating the two units, there is no match of lithology across the zone. As

the sense of shear and the precise stratigraphical separation across the zone are as yet unknown, its significance can only be speculated on from regional considerations. Detailed structural investigation of the site itself and of the rocks immediately north and south could provide an answer to the debate as to whether the Hawick Rocks are younger (Craig and Walton 1959) or older (Rust, 1965) than the Wenlock.

Although recent opinion favours the view that ihe Hawick Rocks are attributable to the Llandovery Series (Kemp, 1986; Kemp and White, 1985; Barnes *et al.,* 1987), the opposing view still has the merit that it requires the least displacement on the fault zone at Burrow Head. Thus, if the red mudstone lithologies in the greywacke of the local Hawick Rocks were transitional downward to the Wenlock, as Craig and Walton (1959) propose, then the Wenlock would lie hidden in the core of the anticline to the north of the fault zone illustrated in (Figure 2.12)A and (Figure 2.12)B. The red mudstones, to the south of the fault, would lie above the Wenlock in the core of the synclinal complex which lies south of the site. Displacement on the fault zone might then be a few hundred metres, but downwards on the north side.

On the other hand, if Rust (1965) is correct in his view that north of the anticline (north-west of the site) there is a sequence of Hawick Rocks (Rust's Carghidown and Kirkmaiden Formations) uniformly dipping and younging to the north-west as far as Kirkmaiden, then a 2–3 km displacement would be necessary, downwards on the south side of the fault zone shown in (Figure 2.12)A and (Figure 2.12)B. The magnitude of the displacement, in the latter hypothesis, depends very much on the stratigraphical and structural arrangement of the Carghidown and Kirkmaiden Formations. Information relating to this is given in the Geological Survey Memoir (Barnes, 1989). Barnes *et al.* (1987) suggest that the Carghidown Formation (with red-beds) is younger than the Kirkmaiden Formation (with a gradational boundary between them) and may be stratigraphically overlain by the Wenlock rocks at Burrow Head. The structural arrangement, whereby this stratigraphy is obtained, is not yet published, but must involve a new interpretation of folding and/or faulting in the Hawick Rocks.

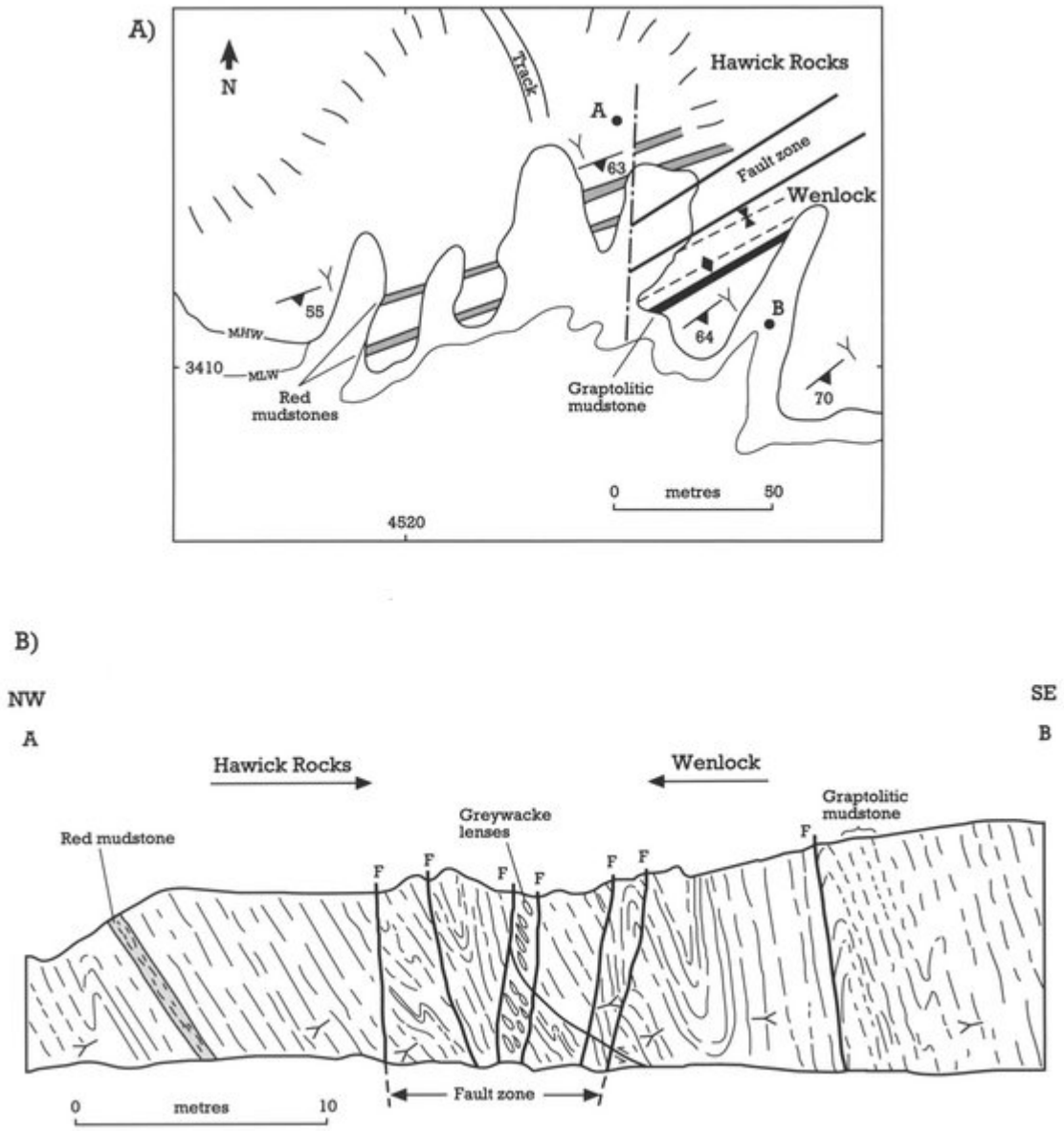
Thus the Burrow Head site is potentially of great importance, in the resolution of two issues in Southern Upland geology. Firstly, there is the question of the age of the Hawick Rocks and all that it implies for the palaeogeography. If the interpretation of a transitional junction is correct then only a small displacement, down on the north side of the fault zone, would be required. Such a fault would not be a major down-to-the-south thrust associated with the accretionary process. On the other hand, a smaller displacement, possibly of D_1 age would explain the lack of high-strain features associated with the fault zone. Secondly, there is the question of the position, age and displacement of the faults which are critical to the interpretation of the structural evolution.

Conclusions

This site is an example of one of the major, steep, strike-parallel fault lines that form an important part of the structural framework of the Southern Uplands. It has been claimed that the fault has a very large displacement of 3000 m, bringing mid-Silurian aged rocks (Wenlock) against early Silurian Hawick Rocks; this dating is based on sparse fossils found in these marine sediments. The displacement of the fault depends on the precise dating of

the rocks on its two sides, and an alternative 'structural' interpretation has been proposed which would make the fault a far less important structure. The settlement of the controversy over this major Southern Uplands discontinuity, will have considerable repercussions on the study of the geological framework of southern Scotland.

References



(Figure 2.12) West Burrow Head. (A) Geological map of site. (B) Sketch cross-section along line A–B of Figure 2.12A).