Siccar Point

[NT 8118 7100]–(NT8130 7095)

J.E. Treagus

Highlights

Siccar Point is one of the world-renowned localities where Hutton (1795) first recognized the significance of unconformities in the geological record. In the context of this volume, it exemplifies the style of folding in the Silurian, which led Hall (1815) to make his important deductions concerning the relationship of stress to the formation of folds, through experiments.

Introduction

This coastal site exposes the angular unconformity between: 1. beds of Llandovery greywacke and shale; 2. beds of Upper Old Red Sandstone (ORS) breccia and sandstone (Figure 2.3). The tight folding and cleavage of the end-Caledonian deformation, seen in the Silurian, contrast strikingly with the gentle dips of the ORS. The breccias contain fragments of cleaved Llandovery rocks. The site was one of the localities at which the significance of unconformities in the geological record was first appreciated (Hutton, 1795; Playfair, 1805). Moreover, the folds in the Silurian of this coast, so well seen in the site, are those which inspired Sir James Hall (1815) to undertake his early experiments in model rock deformation.

Description

The Silurian strata, exposed over about a 100 m^2, are folded in a tight synform, whose limbs dip steeply south, with an interlimb angle of 25°. The fold plunges 35/240°, with its south-east limb overturned and an axial-surface attitude of 080/66°S. Cleavage in siltstones and shales, interbedded with the greywackes, has an attitude 105/74°N and thus transects the axial surface. Way-up structures (bottom structures, graded bedding, and ripple cross-lamination) show the fold to be an upward-facing syncline.

The Old Red Sandstone beds dip gently north; the unconformity surface, although broadly parallel to this dip, exhibits local irregularities due to differential erosion (often along strike) of the underlying greywackes and shales (Figure 2.3).

These irregularities cause certain greywacke beds to protrude several metres above the principal planar unconformity surface. Indeed, the whole synclinal fold, described above, is one such major irregularity protruding above the unconformity surface.

Interpretation

The principal interest of this site is that it displays, in a unique three-dimensional manner, Silurian rocks, folded and cleaved during the Caledonian Orogeny, eroded probably during mid-Devonian times and subsequently overlain by the terrestrial Upper Old Red Sandstone. However, it also exemplifies the style of D_1 deformation seen locally. There is no modern description of the structure of this coast, except where the folds show the complex curving hinges (Dearman *et al.,* 1962), described at John's Road also in the Central Belt. It is, therefore, of interest that this site shows very similar features to those described to the south-west, showing the persistence of such features, especially the same clockwise transection of folds by cleavage.

This site is the only locality in the Southern Uplands where the three-dimensional nature of the unconformity can be clearly seen. The contrast between the vertical greywacke and the horizontal red sandstones led to an understanding, not only of the fundamental earth movements that rocks undergo (Hutton, 1795), but also to an appreciation of the scale

of erosion involved and thus to the immensity of geological time. The style of the folding along this coast, exemplified by this site, also led Sir James Hall (1815) to perform his early experiments and to make important deductions concerning the relationship between stress and folding, specifically that horizontal crustal shortening could be responsible for folding.

The unconformity at Siccar Point, though renowned for Hutton's appreciation of the significance of the phenomenon, does not in fact constrain the 'end-Caledonian' climax in the Southern Uplands very tightly. Elsewhere, in the south-western Southern Uplands, Wenlock rocks are unconformably overlain by Upper ORS sediments and intruded by post- or syn-deformation granites dated about 400 Ma. Nearer the present site, at St Abb's Head, folded Llandovery rocks are unconformably overlain by Lower Devonian lavas, and in the Cheviots probable Wenlock rocks are overlain by lavas of the same age. The possible age of the Caledonian deformation events is discussed in the Introduction to this chapter.

Conclusions

This site has been included as a unique and historic locality in the Southern Uplands to demonstrate the unconformity between the Silurian greywackes, strongly deformed in the Caledonian Orogeny, and the flat-lying undeformed Upper Devonian red sandstones. It also illustrates the D_1 deformation style of the north-eastern exposures of the Central Belt; the truncation of D_1 folds, at the locality, by the flat-lying Upper Old Red Sandstone breccias and sandstones is the clearest example in the Southern Uplands, of the timing of the Late Caledonian deformation. It allows a comparison with the similar style of deformation seen in exposures to the south-west at Barlocco, Cruggleton Bay, and West Burrow Head; that is, the asymmetry of the fold, the attitude of its limbs, axial-surface, fold hinge, and the clockwise transection of the cleavage.

References

(Figure 2.3) Siccar Point. Subvertical Silurian greywackes and cleaved shales on the south limb of a tight Caledonian syncline are unconformably overlain by Upper ORS breccias and sandstones. View looking east with lens cap (centre) for scale. (Photo: J. Roberts.)