Craighead Quarry

[NS 232 012], [NS 234 014]

Introduction

Craighead Quarry is of international significance. Richly fossiliferous, it is the type locality for numerous species. It shows a complex development of limestone types and an unconformable surface of considerable relief between the Ballantrae ophiolite and its overlying sedimentary cover sequence. Not only is this a rare insight into such a surface, but its mid-Caradoc age is crucial to the understanding of the Ordovician development of the southern edge of the Midland Valley Terrane.

The quarry complex at Craighead, north of Girvan, is the type and only major outcrop of the Craighead Limestone Formation. The formation can be seen to overlie the Ballantrae Complex (Figure 14.1) and comprises a variety of lithologies not seen elsewhere in the Girvan succession. The site is unique in the British Isles in showing in detail the transgression of a sedimentary succession over the highly irregular topography of an ophiolitic basement. The Craighead Limestone Formation was originally correlated with the only other major limestone formation in the Ordovician of the Girvan district, the Stinchar Limestone (Lapworth, 1882). With the study of the fossils, this view became less widely held from the early 1930s onward, culminating in Williams' (1962) correlation of the Craighead Limestone with part of the Ardwell Group, south of Girvan. This significantly younger age is important in interpreting the history of the Midland Valley Terrane, in that it helps demonstrate the progressive northward transgression of the Ordovician cover sequence above the ophiolite across a series of fault-bounded blocks. Graptolites and trilobites enable correlation with the middle Caradoc of the Anglo-Welsh area and the upper Mohawkian of eastern North America respectively.

Description

This site comprises a large abandoned quarry complex west of Craighead farm and three smaller quarries to the south-west (Figure 14.12). Williams (1962, p. 48, pl. 4) published maps and measured sections of the quarries that formed the basis of those produced by Tripp (1980b), Bergström (1990) and Ingham (1992c).

Williams' work remains definitive, although Ingham (1992c) provided a more recent synthesis as part of a field excursion guide to the Craighead Inlier. The quarries expose the Craighead Limestone Formation and its unconformable relationship to the underlying spilites and cherts of the Ballantrae Complex. The formation is overlain by fine-grained greywackes of the Plantinhead Flags, which crop out in the stream section to the immediate east of the site.

Lithofacies interrelationships within the Craighead Formation are complex, especially in its lower parts, above the highly irregular unconformity surface. Interpretation is hindered by folding and faulting, making detailed correlation between quarry faces very difficult. The complicated basal relationships of the formation are best seen along the west faces of the south-west part of the main quarry. Here, the upper parts of a marked topographical high in the underlying Ballantrae Complex are overlain by conglomeratic limestones rich in the calcareous alga *Girvanella,* whereas to the south, away from the high, the basal parts of the Craighead Formation comprise conglomerates containing clasts of spilite, serpentinite and jasper, and are overlain by rubbly limestones. Some limestones in the formation are conglomeratic, others nodular, yet others contain an appreciable siliciclastic component. Many contain *Girvanella,* and some are crinoidal or otherwise bioclastic. Williams (1962) provided an outline of the distribution of the different lithologies and their likely lateral correlation within and between the quarries.

In addition to the variety of limestone types, the Craighead Formation includes two mudstone intercalations. The lower one, the Sericoidea Mudstone Member, is exposed above the ramp leading down the western side of the main quarry complex, and the upper one, the Kiln Mudstone Member, occurs at the southern end of the main quarry by (and beneath) the ruined kiln, and also in the quarries to the southwest. Evidence from these latter exposures shows that the Kiln Member lies within the higher limestones of the Craighead Formation.

Many of the lithologies of the Craighead Formation are richly fossiliferous, and the unit has provided the type material for a great many species. In particular, 43 species of brachiopod and 28 of trilobite have their type material from the Craighead quarries. Reed (1935) published extensive lists of brachiopods (Figure 14.13)c, d, trilobites, bivalves, gastropods, corals (Figure 14.13)a, b and graptolites from the quarries, but his lists do not differentiate between faunas from the limestones and those from the two mudstone intercalations. The diverse brachiopod (Williams, 1962) and trilobite (Tripp, 1954, 1980b) faunas have received modern monographic revision. Both are strongly Laurentian in aspect and show marked differences between the limestone and mudstone. Tripp's list (1980b) also shows significant differences between the two mudstone faunas.

Interpretation

A detailed sedimentological interpretation of the Craighead Limestone Formation is still required but the formation is unique in Britain in showing fine details of transgression of a sedimentary succession over the highly irregular topography of an ophiolitic basement. Moreover, it holds a crucial place in the understanding of the Ordovician history of the Girvan district and hence the southern edge of the Midland Valley Terrane.

The age of the Craighead Limestone has been debated (see Sinclair, 1949). Lapworth (1882) equated it with the Stinchar Limestone. This view was questioned by Ulrich (1930) and a younger age suggested by Reed (1935), whereas Lamont (1935) favoured the earlier correlation. When Anderson and Pringle (1946) described what Tripp (1954) subsequently termed the Kiln Mudstones, they considered that its fauna was equivalent to those of the Balclatchie Group south of Girvan. An even younger age, equivalent to a level high in the the upper Ardwell Group, was suggested by Williams (1962, p. 61), but a slightly lower level within the upper Ardwell group was subsequently indicated by Ingham (1978, p. 173) and has become the accepted view.

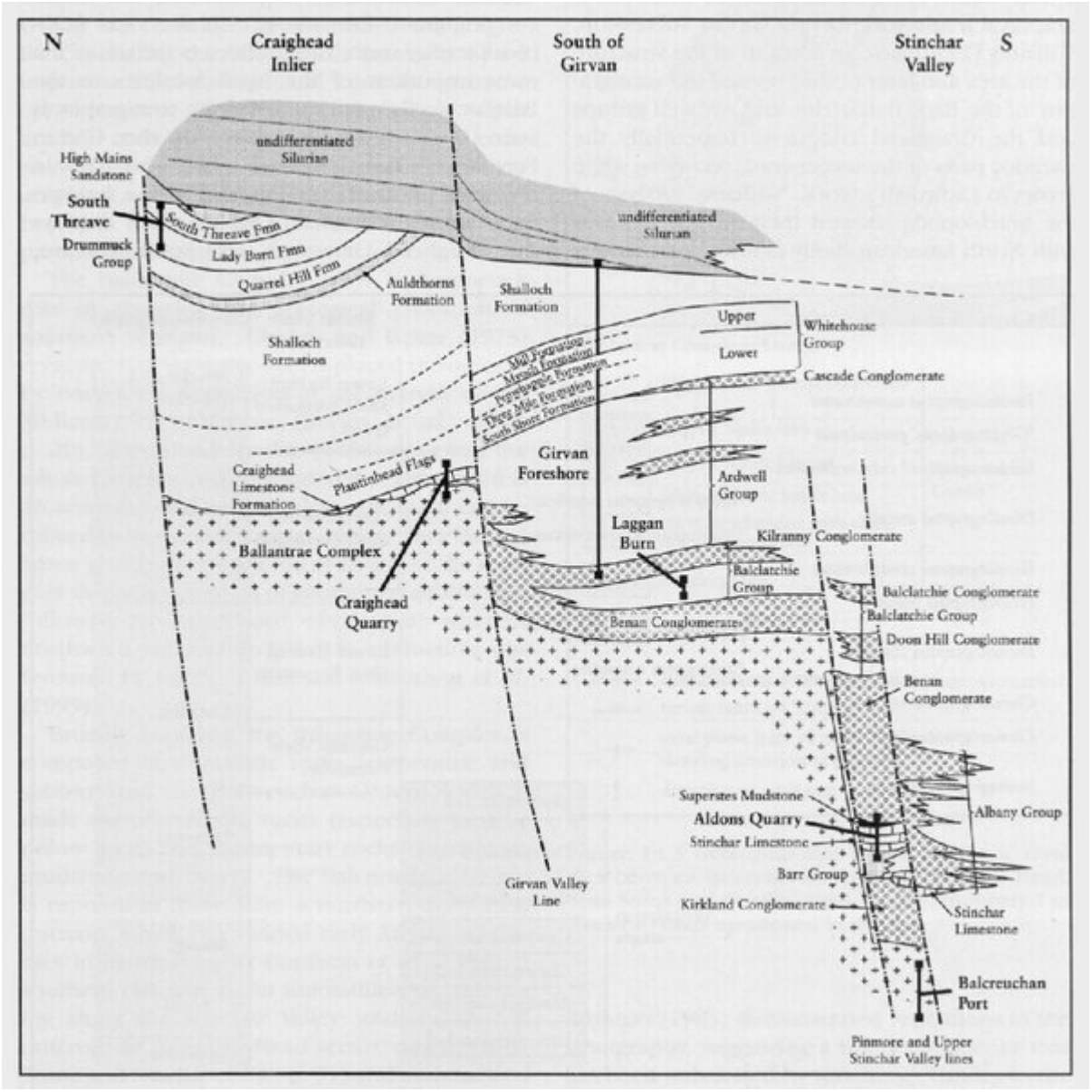
A graptolite fauna from the Sericoidea Mudstone identified by Rickards (in Tripp, 1980b, p. 147) indicates a level low in the *Dicranograptus clingani* Zone (mid-Caradoc), and shelly fossils in the limestones indicate a basal Shermanian age in terms of the former eastern North American chronostratigraphy (Ingham, 1992c, p. 422); this chronostratigraphy has since been revised by Leslie and Bergström (1995). The limestones of the main quarries have yielded few conodonts, but a sample from the topmost limestone below the Kiln Mudstone in Quarry 1 of Williams (1962) contained a fauna that Bergstr6m (1990, p. 11) considered is probably within the *Amorphognathus superbus* Zone but which might be from the *A. tvaerensis* Zone. As with the shelly fossils, the conodont fauna is primarily Laurentian in affinity, although Bergström commented on the absence of certain taxa that elsewhere are commonly associated with those occurring in his sample.

The relatively young age of the Craighead Formation extends the model of the progressive northward transgression of the Ordovician cover sequence above the Ballantrae ophiolite across a series of fault-bounded blocks that is evident in the main Lower Palaeozoic outcrop south of Girvan. In this instance it reflects the transgression over the Girvan Valley line during the mid-Caradoc.

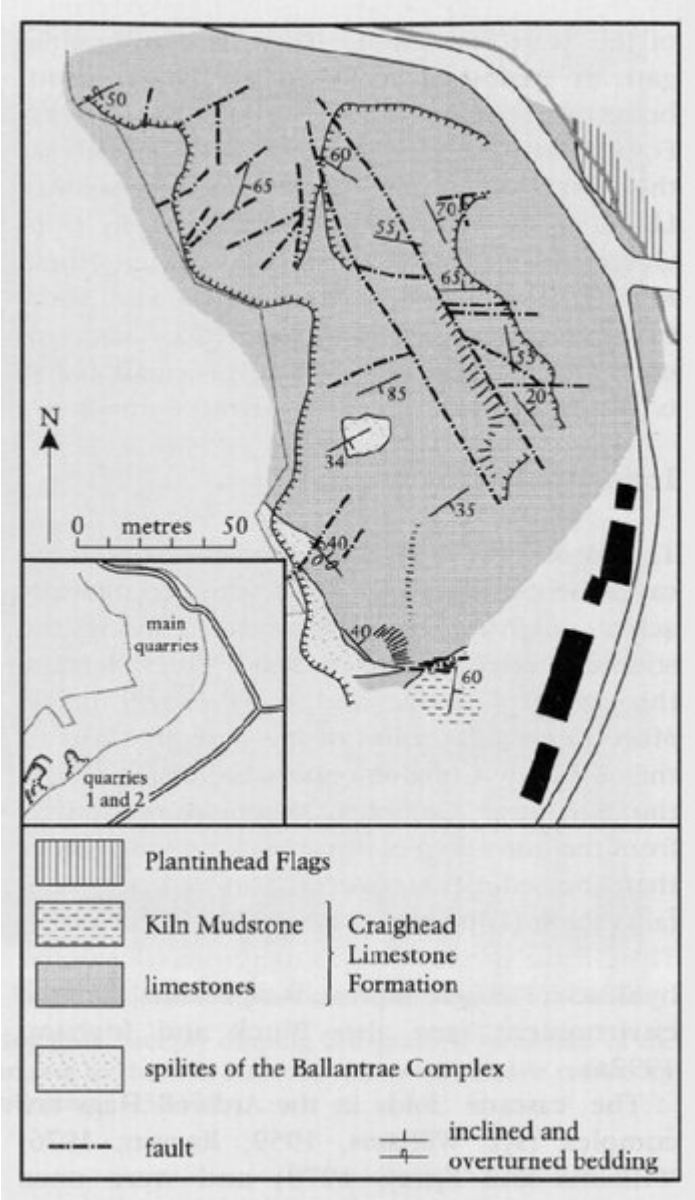
Conclusions

This site is of international importance. It is the type, and by far the best, development of the Craighead Limestone Formation, showing complex inter-relationships between limestone types unique in the Girvan Lower Palaeozoic succession. The formation is richly fossiliferous and is the type locality for many fossil species. At its base, it shows with unique clarity the effects of the drowning of an irregular, eroded surface of the Ballantrae ophiolite. The age of the Craighead Limestone demonstrates that this drowning was a progressive event extending northwards across the Girvan area, across series of fault 'steps'.

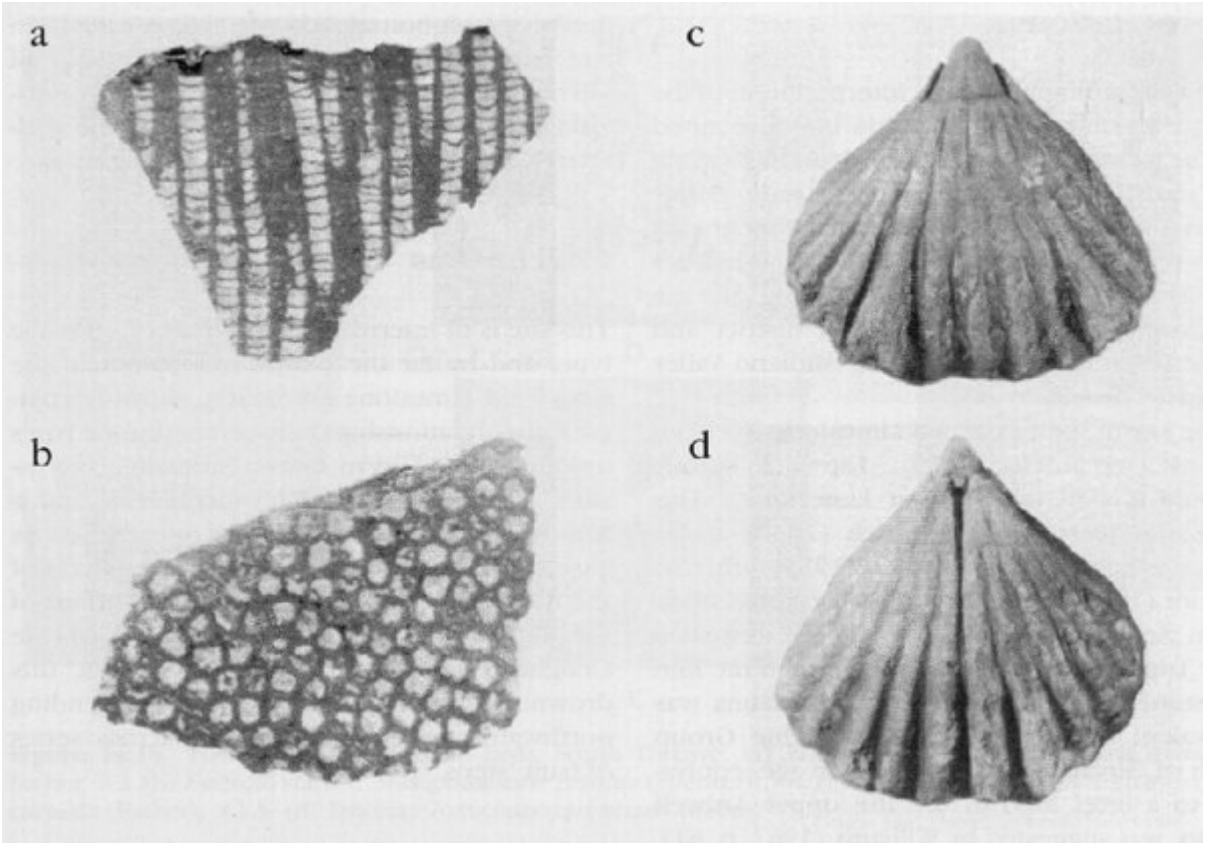
References



(Figure 14.1) Schematic cross-section in the Girvan area to show the stratigraphical and structural relationships across the major south-facing growth faults. The GCR sites are shown in bold type. After Ingham (1992b, fig. 30.5).



(Figure 14.12) Simplified geological map of Craighead Main Quarry, after Williams (1962, pl. 4) and Ingham (1992c, fig. 31.1). Inset map shows the position of the two smaller quarries to the south-west (see Williams, 1962 for details).



(Figure 14.13) Fossils from the Craighead Limestone, Craighead Quarry. (a, b) Lyopora favosa M'Coy, x 2. (c, d) Rostricellula lapworthi (Davidson), x 3.