Laggan Burn

[NX 202 945]–[NX 206 946], [NX 204 947]–[NX 206 947] and [NX 209 943]

Introduction

Rocks of the lower Balclatchie Group exposed in a tributary to Laggan Burn are particularly significant for their fossil content. In particular, the graptolites preserved in three dimensions were the basis of Bulman's classic study (1944–1947) of rhabdosome development and are associated with a diverse conodont fauna of the *Amorphognathus tvaerensis* Zone.

This site was first noted by Lapworth (1882, p. 591), who commented on the existence of graptolites and brachiopods 'in a state of exquisite preservation'. The beds here were subsequently noted by Peach and Horne (1899, p. 512) and described in more detail by Pringle (in Bulman, 1944–1947). The regional geological setting is summarized by Floyd (1999). Bergström (1971, 1990) extracted a conodont fauna, remarkable for both its diversity and the abundance of elements, belonging to the *Baltoniodus gerdae* Subzone of the *Amorphognathus tvaerensis* Zone, which provide the best correlation of this part of the Girvan succession with the international chronostratigraphical schemes. Diverse brachiopod and trilobite faunas known from the site indicate a deep-water setting for the lower Balclatchie Group here.

Description

Laggan Burn and its tributaries north of Dalfask farm reveal several exposures of the lower Balclatchie Group (Figure 14.7). The streambed and sides of the steep gorge (between [NX 2033 9457] and [NX 2057 9460] expose rusty-weathering blue-grey mudstones, siltstones with rarer pebbly horizons, thin limestones and limestone nodules (now very rare). These beds are vertical or dip steeply south and graded bedding shows that they young to the north. On the upper part of the southern bank of the stream [NX 2045 9458], the Benan Conglomerate is thrust over the Balclatchie Group — a boundary that can be traced southwards with some certainty for at least 350 m. Pringle (in Bulman, 1944–1947, pp. i-iii) excavated parts of the tributary section and provided a sketch section and simple log of the beds present there. The banks of the stream are, at the time of writing, overgrown and it is difficult to determine the precise structural and stratigraphical relationship between the various small exposures of the Balclatchie Beds. It is clear, however, that the fault at the base of the Benan Conglomerate is a much lower-angled structure than that shown beneath the 'Balclatchie Grit' (probably a finer lithology within the conglomerate) on Pringle's section. Its southward extension approximately parallels the contours.

Bulman (1944–1947) extracted from certain limestone nodules a diverse graptolite fauna preserved in full relief and showing fine ultra-structural details. Graptolites are also present in the siltstones, where they retain partial relief and in some instances are current-orientated. Bergström (1971, 1990) obtained an abundant and diverse conodont fauna from a limestone bed in the section, and conodonts and scolecodonts also occur in the nodules. A low-diversity association of in-situ brachiopods and trilobites was described by Harper and Owen (1986) from [NX 204 946], and more diverse brachiopod (Williams, 1962) and trilobite (Tripp, 1980a) faunas are known from a little farther east [NX 206 946].

Interpretation

Bulman's study (1944–1947) of the three-dimensional graptolites from Laggan Burn was a seminal work in the study of graptolite ultrastructure and colony development. He described 17 species or subspecies of graptoloids and dendroids, of which five were new. For most species he described a complete set of growth stages, from prosicula to mature rhabdosome, and, together with observations from serial sections, this enabled the recognition of mode of development and proximal growth of several problematic genera. James (1965) described in detail the development of a species of *Dicellograptus* (probably *D. salopiensis* Elles and Wood — see Hughes, 1989, p. 29) from this locality. Although the species present are not stratigraphically very diagnostic, Rushton (in Floyd, 1999) attributed them to the *peltifer* Zone.

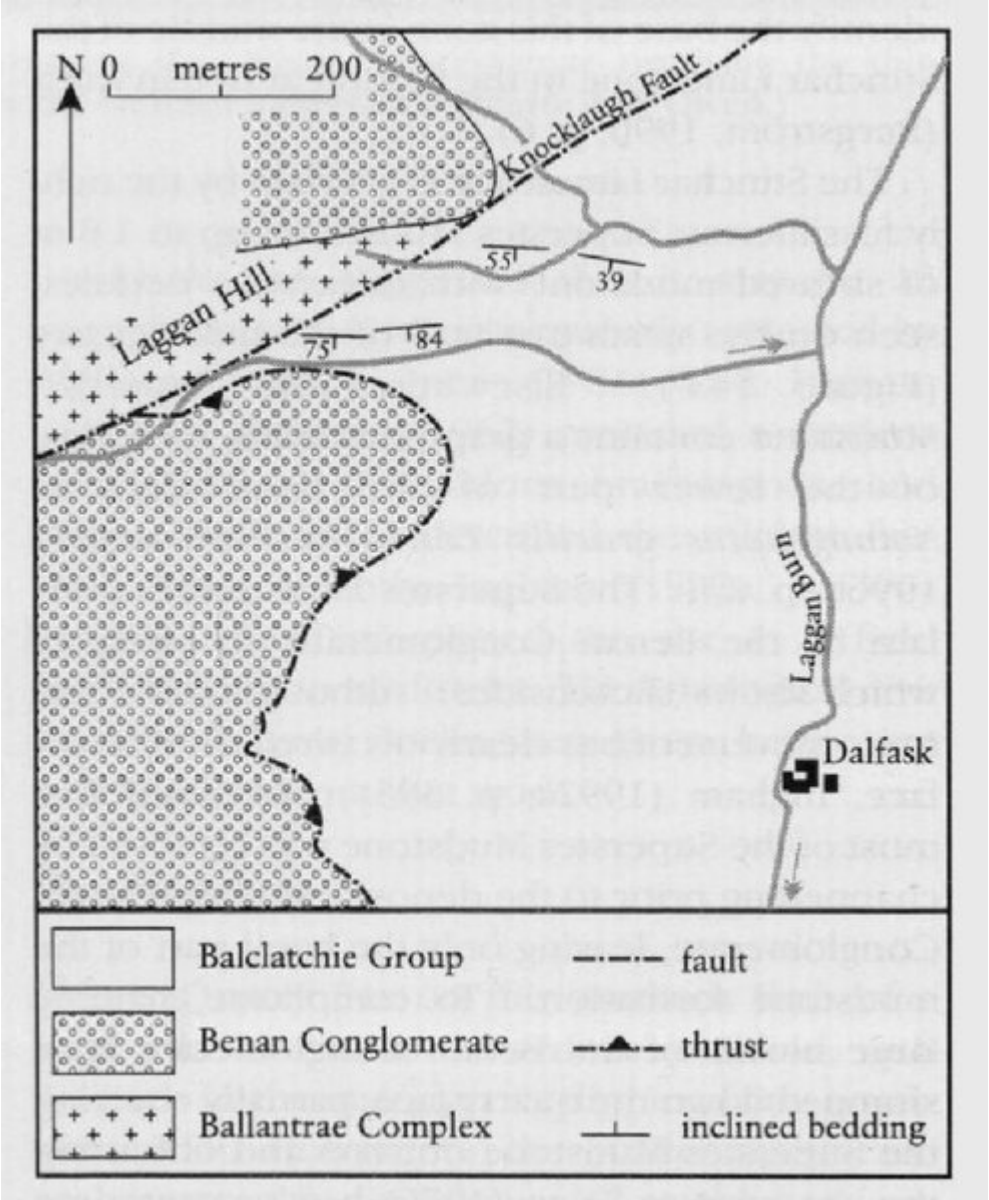
The conodont fauna described by Bergström (1971, 1990, pp. 3, 8–10) is the most diverse such fauna known from the Ordovician of the Girvan district (comprising 11 identifiable form taxa, together with several of uncertain affinity) and has by far the greatest abundance of any Girvan Ordovician fauna, yielding several hundred elements per kilogram, contrasting with fewer than 10 elsewhere. The conodont elements are well preserved but rather broken and, in common with others in the district, have a very low Conodont Alteration Index (1.5–2.5), which contrasts with values in excess of 5 elsewhere in Scotland. The fauna is dominated by elements of *Amorphognathus tvaerensis Bergström*, which (together with *Protopanderodus liripipus* Kennedy *et al.* and *Belodina compressa* (Branson and Mehl)) indicates a level low in the *Baltoniodus gerdae* Subzone of the *Amorphognathus tvaerensis* conodont Zone. Bergström (1971, p. 114) argued that an assignment of Bulman's graptolite fauna to the lower *Diplograptus multidens* graptolite zone (equivalent to the Scottish *peltifer* Zone) would be consistent with this and the known ranges of the graptolites. A correlation with the Harnagian Substage of the Burrellian Stage in the standard Anglo-Welsh Caradoc succession is thus indicated.

Although the conodont fauna and certain graptolites have a widespread distribution, the brachiopods and trilobites emphasize the Laurentian affinities of the Ordovician shelf faunas of Girvan, and thus the palaeogeographical position of the Midland Valley Terrane. Williams (1962, p. 26) listed 16 species and subspecies of brachiopod, and Tripp (1980, table 1) listed 18 species of trilobite. Both authors indicated the strong Appalachian affinities of many lower Balclatchie Group taxa. In particular, Tripp (1980a, p. 135) noted that, as with the nearby exposures at Dalfask, the fauna from the tributary to Laggan Burn includes a large proportion of specimens of *Porterfieldia, Robergiella, Ampyxina* and *Raymondella* that are very close to or conspecific with forms from the Liberty Hall/Athens facies of the Edinburg Limestone in Virginia. Shaw and Fortey (1977, p. 422) considered the latter to be a lower-slope biofacies. A deep-water setting was confirmed by Harper and Owen (1986), who described an in-situ association of two new species, the brachiopod *Onniella williamsi* Harper and the trilobite *Diacanthaspis* (*D.*) *trippi* Owen, from siltstones associated with the limestone nodules in the tributary.

Conclusions

Laggan Burn is internationally significant for its fossil faunas. Graptolites preserved in full relief show very fine details of their skeletal structure, and their study in the 1940s was an important step forward in understanding the biology and classification of these members of the Early Palaeozoic plankton. Conodonts occur in far greater numbers than at any other Ordovician site in the Girvan district and enable this part of the succession to be tied to the standard divisions of Ordovician time. The benthic invertebrates (brachiopods and trilobites) show that the lower Balclatchie rocks here were deposited in deep water on the Laurentian (North American) side of the Iapetus Ocean and differ significantly from contemporary faunas from England and Wales.

References



(Figure 14.7) Geological map of the area near Dalfask, partly after Harper and Owen (1986, fig. 1). The tributary of Laggan Burn yielding the fossil faunas lies immediately north of the thrust which brings the Benan Conglomerate over mudstones of the Balclatchie Group.