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10. Scotland: Hebridean Terrane

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The Cambrian succession in the Hebridean Terrane extends for about 200 km from near Durness on the northern coast of the Scottish mainland SSW to Skye (Fig. 14). The classic account of the whole region is the memoir by Peach *et al*. (1907), which work had a great influence on British geological studies in the Lower Palaeozoic during the earlier part of the 20th century. The geology of the region was described by Park *et al*. (2002) and some critical localities were reviewed by Prigmore & Rushton (1999). Sedimentological studies by Swett and his collaborators (Swett & Smit 1972) and by McKie (1990a-c, 1993) and new litho- and biostratigraphical work, including the study of microfossil faunas and floras, have led to a re-appraisal of the stratigraphical succession and its correlation.

The Cambrian succession (column 22, Fig. 15) consists of a generally upward-fining sequence of clastic deposits, the Ardvreck Group of early Cambrian age, followed by a succession of carbonate formations, the Durness Group, of Cambrian to early Ordovician age. The strata were deposited on a stable, gently sloping shelf, and because the facies represented are generally similar throughout the length of the outcrop, it is inferred that the trend of the shelf lay approximately parallel to the line of the present outcrop (Bluck 2007).

The characteristics of the rocks, and especially of the faunas, have long led to comparison of the Cambrian–Ordovician succession of north-western Scotland with rocks of the same age in North America, whereas the strongly provincial character of the faunas hinders precise correlation with the Avalonian standard. The presence of the typically Laurentian trilobite genus *Olenellus* and the tubular organism *Salterella* allow reference of the Ardvreck Group to the later parts of the early Cambrian (upper part of Series 2?) whilst the shelly, mainly molluscan, fossils from the formations of the upper parts of Durness Group are comparable with those from the zones of the Ibexian Series of the North American Ordovician, which are approximately equivalent to the Tremadoc and Arenig series of traditional British usage. Nicholas (1994) and Wright & Knight (1995) proposed a revised correlation of the Durness

Group, whilst Huselbee & Thomas (1998) discussed the biostratigraphy of the succession.

The lower member of the transgressive Eriboll Formation, the Basal (or False Bedded) Quartzite, is unfossiliferous, except for acritarch assemblages recovered from fine-grained lithologies near Ullapool (Molyneux 2006). The acritarchs comprise almost monospecific assemblages of leiospheres (sphaeromorph acritarchs), accompanied by rare and indeterminate acanthomorph acritarchs in one sample. Such low-diversity assemblages provide no evidence for age, but are suggestive of shallow marine environments, consistent with the transgressive nature of the deposit. The overlying Pipe Rock Member contains abundant burrows of the trace-fossil *Skolithos*, which is characteristic of post-Neoproterozoic rocks. Peach *et al*. (1907, p. 373) recorded the early Cambrian tubular fossil *Salterella maccullochii* in the upper part of this member. The age of the An t-Sròn Formation is more closely constrained by the trilobites and acritarchs recorded from the Fucoid Beds Member. The trilobites are olenellid species, referable to subgenera well known from the Laurentian parts of North America: *Olenellus* (*Mesonacis*) *reticulatus*, *O.* (*Paedumias*) *lapworthi*, with *O.* (*Angustolenellus*) *hamoculus* and *Olenelloides armatus* locally. Palmer & Repina (1993) assigned this fauna to the mid-part of the *Olenellus* Trilobite Zone of the North American standard, which lies somewhat below the higher of the prospective levels at which the boundary between Series 2 and Series 3 is expected to be defined (Geyer 2005, p. 94). Acritarch floras from the Fucoid Beds Member at Knockan, Skiag Bridge and Ullapool, described by Downie (1982; see also Molyneux 2006), include *Asteridium spinosum*, *Cymatiosphaera postae*, *Globosphaeridium cerinum*, *Goniosphaeridium implicatum*, *Goniosphaeridium varium*, *Multiplicisphaeridium dendroideum*, *Revinotesta ordensis*, *Skiagia brevispinosa*, *Skiagia ciliosa*, *Skiagia orbicularis* and *Skiagia ornata*, which taken together indicate the *dissimilare–ciliosa* Acritarch Zone. The first appearance datum (FAD) of *Volkovia dentifera* towards the top of the Fucoid Beds Member at Knockan suggests that the top of the member is in the overlying *dentifera–plana* Acriarch Zone. The acritarchs from the upper part of the Fucoid Beds therefore suggest a level in the upper part of the *dissimilare–ciliosa* Biozone or lower part of the *dentifera–plana* Biozone (Series 2, Stage 4), which in turn suggests correlation with the middle part of the *Bonnia–Olenellus* Trilobite Zone of North America (Fig. 3), and is consistent with the trilobite evidence. The Salterella

Grit Member is named after the abundance of *Salterella*, but has also yielded *O.* (*P.*) *lapworthi* (Peach *et al*. 1907, p. 375).

The lowest division of the overlying Durness Group is the Ghrudaidh Formation, which includes *Salterella* in its lowest part. Huselbee & Thomas (1998) collected an example of *Olenellus* aff. *reticulatus* from the basal Ghrudaidh Formation in a thrust slice near Inchnadamph, Assynt, confirming that the lowest part of the Durness Group lies within the *Olenellus* Biozone. Higher levels in the Ghrudaidh Formation lack fossils.

Huselbee & Thomas (1998, pp. 86-87) demonstrated that the topmost part of the succeeding Eilean Dubh Formation is of earliest Ordovician age, as shown by the occurrence of conodonts, especially the short-ranging species *Cordylodus lindstromi*. Below this the Eilean Dubh Formation has yielded fossils, though nothing stratigraphically very reliable (Huselbee & Thomas 1998). However, Wright & Knight (1995) made detailed comparisons between the Ghrudaidh and Eilean Dubh formations of Scotland and the Port au Port Group in the northern part of western Newfoundland, and they found sufficient similarities in lithostratigraphy and sedimentary facies to propose a direct correlation. As there is a measure of biostratigraphical control throughout the Port au Port Group, it is accepted that the Ghrudaidh Formation extends through much of Series 3 ("Middle Cambrian") and the Eilean Dubh Formation extends through the whole of the Furongian ("Upper Cambrian"). Figure 15 shows this correlation set alongside stratigraphical subdivisions of the Laurentian Cambrian. The divisions Waucoban to Canadian are shown because they were commonly used through much of the 20th century and appear in the older literature. However, the more recently proposed divisions from Montezuman to Ibexan are rigorously defined and can be more reliably aligned with the proposed international standard.

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Fig. 14. Distribution of Cambrian to early Ordovician rocks and the Upper Dalradian Supergroup (Neoproterozoic to Cambro-Ordovician) in Scotland.

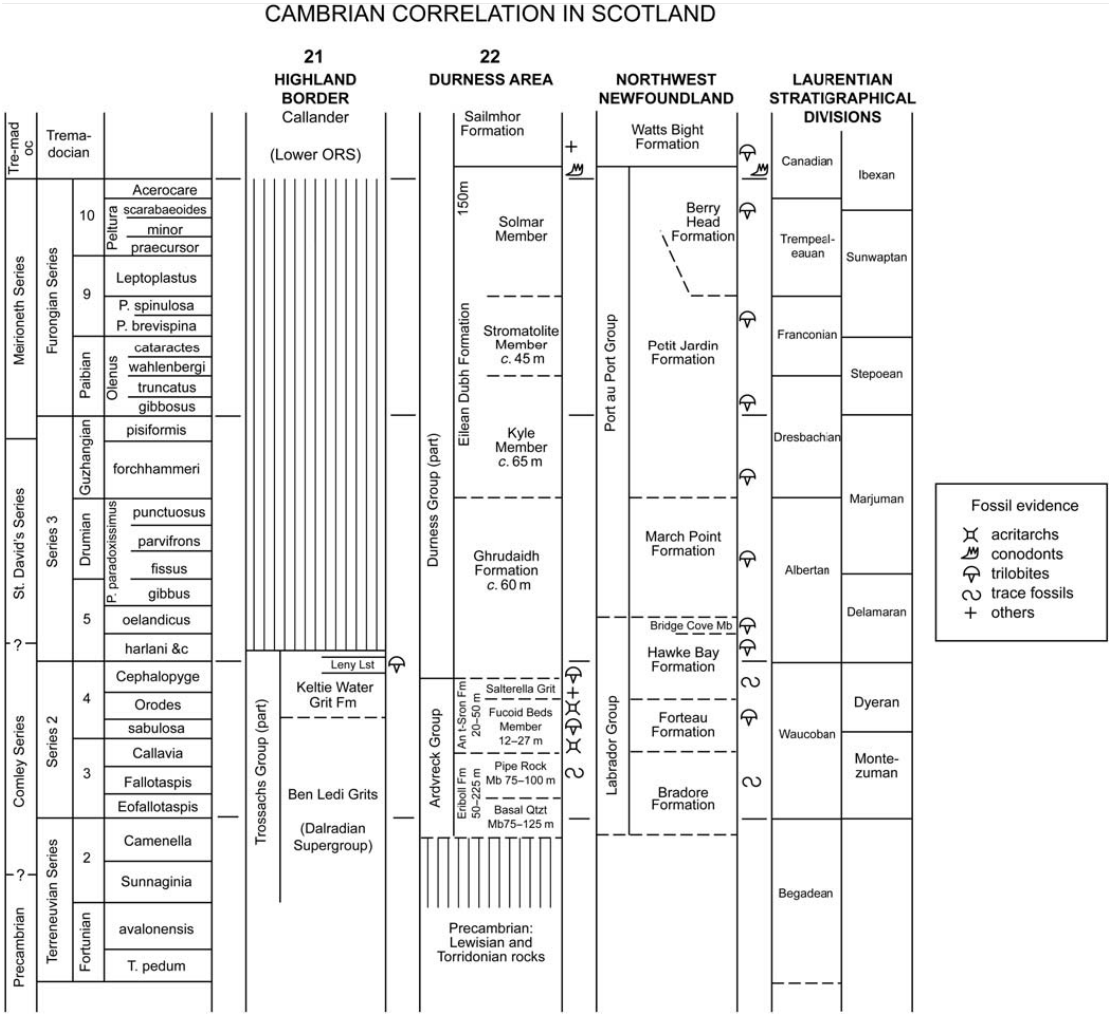

Fig. 15. Correlation of Cambrian rocks in Scotland. Column 21 shows the Trossachs Group of Tanner & Sutherland (2007) as the upper Dalradian on the southeast edge of the Central Highlands Terrane. Column 22 shows the succession in the Northwest Highlands (Hebridean Terrane), and its correlation to the succession in northwest Newfoundland (Wright & Knight 1995) and the Laurentian standard.