Letter to the Editors

Sedimentation and tectonics in the Scottish Dalradian: Comment

Sirs——Anderton's (1985) review of Dalradian sedimentation and tectonics must represent a milestone in the history of Dalradian research, in that, for the first time the ourcrop pattern of Dalradian units and their sedimentological features have been fitted into a regional model which, in my opinion, forms a basis for speculation. Since Anderton draws from my work at Loch Creran (Litherland 1980) as one of the key areas where Dalradian units can be mapped across the strike for considerable distances, I raise the following points with respect to his reinterpretation of that area and the Dalradian as a whole.

1. Anderton's figure 4a now elegantly accounts for the gradual disappearance of recognisable Appin Group units eastwards across Loch Creran (Litherland 1980, fig. 6) and their subsequent reappearance in the Blair Atholl–Schiehallion district further east (Smith and Harris 1976; Treagus and King 1978). This phenomenon had long been a puzzle to me.

2. Anderton (1985), following Soper and Anderton (1984), believes the Benderloch slide to be a re-activated syn-depositional fault and thus agrees with my own interpretation (Litherland 1982). Does Anderton believe this structure to be refolded by D_2 further NE to form the Iltay Boundary Slide of the Central Highlands after Roberts and Treagus (1977)? His model would not indicate as such and I have strong reservations myself (Litherland 1982).

3. Anderton does not account for the absence of the Port Askaig Tillite at Glen Creran (Litherland 1980) nor the fact that in the same area, at levels equivalent to the tillite or below it, there exists the Beinn Sgulaird Quartzite comprising metre-thick graded units which must be the oldest turbidites of the Dalradian.

4. With regard to the Argyll Group correlation of the Ardmuchnish and Creran Successions of Loch Creran (Litherland 1980), Anderton's attempt to correlate the two sequences based on the recognition of shallow water and deep water divisions may seem simple but it does not correspond to field observations. The Beinn Donn Quartzite, equivalent, in part, to the Carn Mairg Quartzite, is of deep-water facies in the east of the Loch Creran area, but around the hinge of the Beinn Donn Syncline, where 19 members have been individually mapped (Litherland 1980, fig. 2; Litherland 1982, fig. 3), the formation comprises shallow-water rocks with cross-bedding, pebbly seams and dolomitic spots (Litherland 1980). It thus resembles in every way the Jura Quartzite of the Ardmucknish Succession in the west. Furthermore this pattern of facies change is repeated in lower units of the Creran Succession (Litherland 1980, fig. 7). It is thus my opinion that the Carn Mairg Quartzite and Killiecrankie Schist can be traced in the field into the Jura Quartzite and are not part of the Easdale Subgroup as shown on Anderton's figure 1. In conjunction with point 3 (above) it is clear that turbidite

basin(s) developed during Jura Quartzite times and that Dalradian sedimentation cannot be represented by the single column of Anderton's figure 1.

5. Within the Easdale Slates of the Ardmucknish Succession lies the Selma Breccia Formation at the same stratigraphic level as the Scarba Conglomerate (Litherland 1975, 1980). This contains exotic limestone clasts with oncolites (carbonaceous oolites) and catagraphs, correlated with Vendian forms from Russian and Sptizbergen (Litherland 1975), and pebbles from a ?bryozoa-like reef. This correlation could be used as evidence for a post-Easdale Subgroup age for the Iapetus Ocean. Similar, though less well-preserved, ?bryozoa structures occur in slumped fragments in the Tayvallich Limestone (Gower 1973). I considered (Litherland 1975) the Selma biota to be derived from the NW, possibly from the Durness Limestone, but Anderton (1985, p. 427) suggests that this region was the source of clastic supply during this period. How does Anderton fit this important palaeontological discovery into his scheme?

6. It is interesting to note that Anderton's tectonic block model (1985, fig. 7) is in sympathy with my structural model (Litherland 1982) in which a basement massif determined the major change of facing of first folds across the SW Highlands.

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Letter to the Editors

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Sirs——I am especially pleased to reply to the points raised in Litherland's letter because, as a result of his careful and objective mapping, originally presented in his thesis (Litherland 1970), he was one of the first people to demonstrate the true stratigraphic complexity of the Dalradian. It is the search for the causes of this complexity that is now providing new insight into Dalradian evolution.

I acknowledge point 1 and agree with point 2. It is unlikely that the Benderloch Slide is folded back to form the Iltay Boundary Slide. I will discuss this in more detail elsewhere but, briefly, I follow Thomas (1979) in considering that the Benderloch Slide can be traced via the Ballachulish Slide into the Ossian steep belt.

Point 3 relates to the interpretation of the field relationships of the Beinn Sgulaird Quartzite. As this lies between a stratigraphically thin Appin Group succession to the west and the Etive granite on the east, Litherland (1980, fig. 7) assumes that it occupies the same horizon as the Port Askaig Tillite and Jura Quartzite. He thus invokes major lateral facies changes in the Islay Subgroup rocks. However, the field relationships shown by Litherland (1980, fig. 2) are far from unequivocal and I think it is more likely that the Beinn Sgulaird Quartzite forms part of the Easdale Subgroup, there being a stratigraphic break and/or fault at its base. The absence of the tillite is in no way surprising in an area of slow subsidence throughout Appin and earliest Argyll Group times.

The differences of opinion discussed under point 4 result from different interpretations of the environments of deposition of the Beinn Donn Quartzite. Litherland contends that it changes from a turbiditic facies, to a shallow water facies as it is traced around the hinge of the Beinn Donn syncline. However, distinguishing between shallow and deep water facies in these moderately deformed quartzites is not as straightforward as he implies. For example, large-scale cross bedding is frequently found in Argyll and Southern Highland Group submarine fan channel sands and thus is not an indicator of shallow water. I think that the facies changes in the Beinn Donn Quartzite and adjacent formations are likely to represent different sub-environments of a complex base-of-slope turbidite sequence. Therefore, I reject any correlation of the Jura Quartzite with the Beinn Donn Quartzite and thus with Cairn Mairg Quartzite and I place the latter two units firmly in the Easdale Subgroup. Notwithstanding the lateral facies changes described by Litherland (1980), I think the Loch Creran area is similar to the rest of the Scottish Dalradian in that upper Islay Subgroup times were dominated by shallow shelf depositoin and that the base of the Easdale Subgroup is marked by rapid subsidence and a change to deep water sedimentation.

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I agree that the limestone clasts in the Selma Breccia are most likely to have been derived from a source area to the NW (point 5). The limited extent of this unit implies that this source was very local, the shape and size distribution of the clasts show that transport was limited. Perhaps they were derived from the uptilted edge of the fault block lying immediately to the NW of the Benderloch Slide. Although this edge was probably cut by canyons bringing clastics into the Easdale Slate basin from the NW, parts of the edge could have formed sediment-starved shoals suitable for *in situ* carbonate production. Minor uplift could have readily led to rapid lithification and shedding of carbonate clasts over the fault scarp into the basin. The presence of local carbonate shoals to the NW does not preclude the NW from being the major source of clastic detritius. The Durness Limestone is not relevant because it is very much younger than the Easdale Subgroup (Anderton 1985, p. 422).

I think that the "basement massif" of Litherland (1982) does exist and has influenced the structural development of the area (point 6). It was an area of slow subsidence flanked by thick sedimentary basins to the NW and SE.

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