9 Kinloch Laggan Road A86

[NN 5440 8975]–[NN 5500 8980]

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9.1 Introduction

A number of boulder beds interpreted to be of glacial origin have been recognized within the Grampian Highlands. Their significance lies not only in their record of the Earth's past glacial history but also in their potential value as chronostratigraphical markers. The thickest and most extensively developed is the Port Askaig Tillite, which can be traced from the type area on the Isle of Islay, north-eastwards through Perthshire and into the North-east Grampian Highlands (see the *Garvellach Isles*, *Tempar Burn* and *Muckle Fergie Burn* GCR site reports in Tanner et al., 2013a, Treagus et al., 2013 and Stephenson et al., 2013b respectively). Other boulder beds are much more restricted in their geographical occurrence. The Kinloch Laggan road section contains the type locality for the Kinlochlaggan Boulder Bed. Here, adjacent lithologies allow the stratigraphical position of the boulder bed to be determined and the excellent glacially smoothed exposures have prompted some re-assessment of the nature of the deposit. The results of recent mapping by the British Geological Survey on 1:50 000 Sheet 63E (Dalwhinnie, 2002) have traced lenticular occurrences of boulder bed to the south-west along the west-north-west limb and around the hinge of the major Kinlochlaggan Syncline (see the *Aonach Beag and Geal-charn* GCR site report).

The Kinlochlaggan Boulder Bed was first recognized and interpreted as glacial in origin by Treagus (1969). The unit occurs within a sequence of quartzites, pelites and metacarbonate rocks that were attributed by Treagus to the lower part of the 'Ballachulish succession' of the Dalradian. The succession was thought to occur within the core of the Kinlochlaggan Syncline and to be surrounded by older rocks of the 'Moine Series' (Anderson, 1947b, 1956; Smith, 1968), the latter now assigned to the Grampian Group. Subsequent work has generally assigned the boulder bed more precisely to the Lochaber Subgroup of the Appin Group (Thomas, 1979; Treagus, 1981; Robertson and Smith, 1999). However, Piasecki and Temperley (1988a) equated the succession at Kinloch Laggan, including the boulder bed, with the 'Ord Ban Subgroup', now the Kincraig Formation at the base of the Corrieyairack Subgroup of the Grampian Group. At the opposite extreme, Evans and Tanner (1996) suggested that the boulder bed is equivalent to the Port Askaig Tillite at the base of the Islay Subgroup of the Argyll Group.

9.2 Description

The type locality for the Kinlochlaggan Boulder Bed is a small roche moutonnée beside the A86 road at Kinloch Laggan [NN 548 897] (Figure 5.25). The boulder bed occurs within a near-vertical, NNE-striking succession of quartzite, semipelite, metacarbonate-rock and calcsilicate rock exposed on the west-north-west limb of the upright Kinlochlaggan Syncline (Anderson, 1947b).

The boulder bed consists of a sequence, over 20 m thick, of quartzite and psammite. The north-western part comprises 7 m of massive pebbly quartzose psammite or quartzite that is apparently unbedded apart from some poorly developed micaceous partings and colour lamination. Clasts are relatively abundant, poorly sorted, matrix supported and unevenly distributed (Figure 5.26). Treagus (1969, 1981) recognized 'several thousand stones' per square metre within the size range 3 to 30 mm. Most clasts are less than 3 cm long and many are less than 1 cm with only 20 counted in the range 8 to 10 cm. Treagus reported that approximately 75% of the 'stones' are of alkali granite with the remainder being quartzite, pelite or semipelite. Numerous pink feldspars could be either clasts or porphyroblasts, whereas quartz-feldspar aggregates are thought to be clasts. Numerous weathered-out hollows on exposed surfaces are thought to indicate former positions of clasts. One clast of semipelite is 9 cm long and 1.5 cm across and contains two tectonic fabrics, the

later of which is parallel to both the long axis of the clast and the fabric in the host quartzite. Only one large boulder is present. This is 40 cm by 16 cm, subrounded and composed of granite. It contains a foliation parallel to both the long axis of the boulder and the fabric in the host quartzite.

The clast-bearing lithology is succeeded to the south-east by 6 m of non-pebbly psammite and then by 7 m of psammite containing scattered clasts that are lithologically similar to those in the first unit. Only 6 clasts in the size range 8 to 10 cm have been recognized; smaller 3 to 30 mm clasts are more abundant but widely scattered. Treagus (1969) reported traces of bedding lamination and that the bedding planes are deformed locally in the matrix beneath some of the clasts. Thin granite veins cross-cut the second clast-bearing unit.

The contacts between the boulder bed and the adjacent lithologies are not exposed in the road section. The nearest exposures of the Kinlochlaggan Quartzite Formation are 60 m away to the west, forming the prominent cliffs behind Kinloch Laggan village hall and smaller exposures on the roadside. There are no exposures in the intervening ground. However, 16 km to the south-west, both in Coire Cheap [NN 4176 7566] and near Aonach Beag [NN 4554 7375], the boulder bed is seen to be conformable with the quartzite. Furthermore, preserved cross-bedding in the Coire Cheap area clearly shows that the quartzite underlies the boulder bed.

At Kinloch Laggan, the Kinlochlaggan Quartzite comprises 150-200 m of massive white quartzite with bedding defined only by variations in colour. Large, white to pink feldspar crystals are a widespread feature. Two subangular granitic clasts 15 mm long occur in roadside exposures at [NN 5459 8976]. Younging evidence is sparse and is confined to possible examples of cross-bedding, which do not give a conclusive answer.

The quartzite is well exposed and forms numerous glacially smoothed surfaces on the hillside along strike to the north-east. Vertical faces at [NN 556 906] show prominent gently plunging rodding lineations. Some surfaces show two slightly oblique linear structures, an earlier rodding lineation, which is co-axial with the large-scale folds such as the Kinlochlaggan Syncline, and a later lineation marked by the hinges of small-scale crenulations or corrugations.

The Kinlochlaggan Quartzite overlies a dominantly semipelitic unit referred to as the Aonach Beag Semipelite Formation. The contact between the semipelite and the quartzite is gradational through a zone of interbedded quartzite and semipelite that is well exposed on the hillslope to the north-west of Kinloch Laggan around [NN 551 904]. The contact between the lowest exposed part of the semipelite and the Grampian Group to the north-west is interpreted as a slide (Figure 5.25). However, to the south-west, in the Coire Cheap area, the contact is locally conformable and transitional (Robertson and Smith, 1999).

To the east of the boulder bed, the overlying succession is dominated by metacarbonate rocks, calcsilicate rocks and semipelites assigned to the Coire Cheap Formation. Amphibolite sheets are widespread. The nearest exposures to the boulder bed, less than 10 m away across strike, occur in a small disused limestone quarry. On the west wall of this quarry, stratigraphically closest to the boulder bed, 1 m of schistose biotite-muscovite semipelite is succeeded to the east by approximately 1 m of biotite semipelite composed of biotite, plagioclase, quartz, clinozoisite and accessory tourmaline. Some 20 to 30 cm of vein quartz separates this from *c.* 16 m of metacarbonate rock. The lowest part of the metacarbonate rock is pale grey and contains both dolomite and calcite. The remainder is massive, coarsely crystalline and grey-blue with brown-weathering surfaces. Micaceous partings separate metre-thick units of metacarbonate rock. Brown-weathering upstanding ribs, resulting from a greater abundance of calcsilicate minerals, show tight to isoclinal folds with a strong co-axial ribbing lineation. Approximately 1 m of rusty-weathering biotite semipelite occurs on the east wall of the quarry. A second quarry immediately to the east contains 13 m of metacarbonate rock that is lithologically similar to the bulk of the first quarry. Farther to the east, schistose semipelite to pelite contains a 3 m-wide sheet of garnet amphibolite; the garnets are largely replaced by feldspar.

9.3 Interpretation

The Kinlochlaggan Boulder Bed has been interpreted as glacial in origin on the basis of the occurrence of matrix-supported extrabasinal granite clasts, and the unbedded psammite units containing the clasts were originally interpreted as tillites (Treagus 1969, 1981). However, the quartz-rich and mica-poor character of the sequence indicates

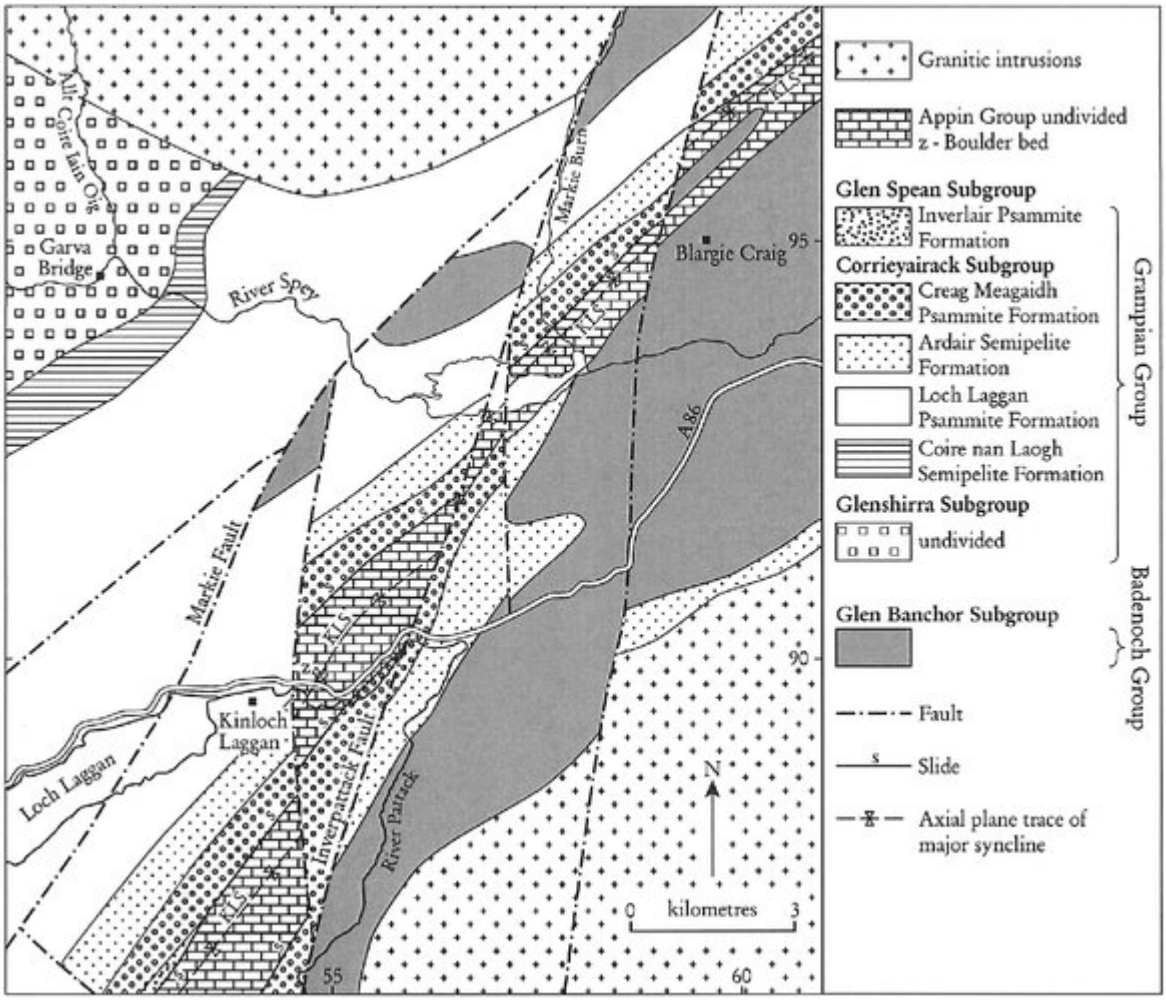
that it was derived from a relatively mature sandy sediment, more typical of a clastic water-lain origin than a subglacial till. The immediately underlying quartzites of the Kinlochlaggan Quartzite are likely to have originated on a shallow marine shelf. Therefore the extrabasinal clasts are best interpreted as ice-rafted dropstones, a feature supported by the apparent deformed bedding lamination beneath some clasts reported by Treagus (1969). These features are preserved in spite of intense folding and metamorphic recrystallization at kyanite to sillimanite grade.

The boulder bed occurs within a heterogeneous succession of semipelites, quartzites and metacarbonate rocks, which stratigraphically overlies the Grampian Group. Therefore the suggested correlation with the 'Ord Ban Subgroup' (now the Kincraig Formation at the base of the Corrieyairack Subgroup) is untenable. The boulder bed occurs above and in stratigraphical continuity with the Aonach Beag Semipelite Formation and Kinlochlaggan Quartzite Formation. Collectively, these two units are lithologically similar to the Loch Treig Schist and Quartzite Formation, which forms the lower part of the Lochaber Subgroup in the Loch Treig area to the south-west of this GCR site (Key *et al*., 1997). The boulder bed is therefore assigned to the Lochaber Subgroup of the Appin Group (Figure 5.27). The overlying metacarbonate-bearing succession of the Coire Cheap Formation, which is separated from the boulder bed by some 10 m of unexposed strata, has no correlative in the Loch Treig area. However, there are similarities in terms of the lithologies and the geochemistry of the metacarbonate rocks with the upper part of the Ballachulish Subgroup in the Schiehallion area, which represents the closest Appin Group rocks to the south (Thomas *et al*., 1997). Such a correlation requires that the upper part of the Lochaber Subgroup and the lower part of the Ballachulish Subgroup are absent from the Kinloch Laggan area (Robertson and Smith, 1999). The much more-extensive Port Askaig Tillite occurs at the base of the Islay Subgroup, stratigraphically well above the metacarbonate-bearing successions of the Ballachulish Subgroup.

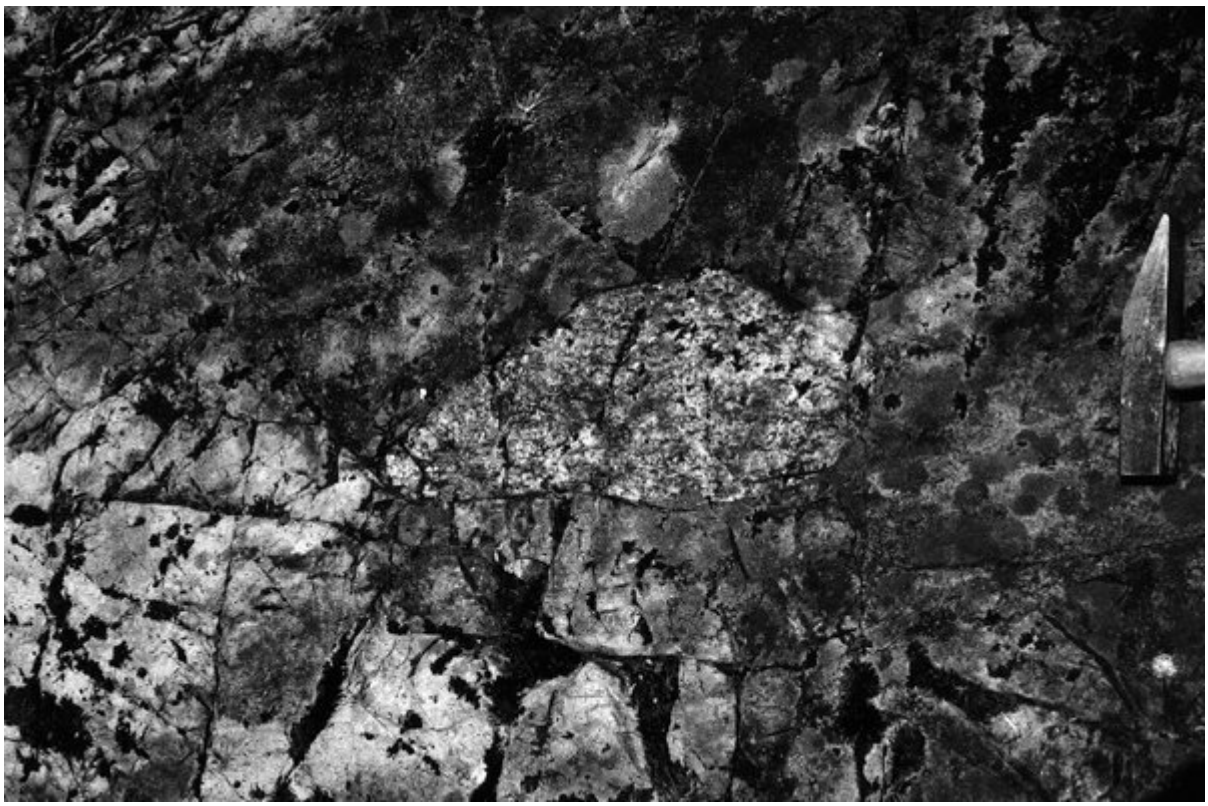
9.4 Conclusions

The Kinloch Laggan Road GCR Site contains the type locality for the Kinlochlaggan Boulder Bed, which represents one of a number of boulder beds containing extrabasinal clasts within the Dalradian succession. The clasts of granite, together with quartzite, semipelite, pelite and feldspar are interpreted as dropstones from floating ice rather than being derived from till beneath a grounded ice-sheet. The boulder bed occurs within a conformable stratigraphical succession that can be correlated with the Lochaber Subgroup of the Appin Group. It lies beneath a significant intra-Appin Group unconformity in the local succession where the upper parts of the Lochaber and lower parts of the Ballachulish Subgroup are absent. The site is of national importance in demonstrating the earliest recorded glacial influence within the Dalradian. When combined with the Port Askaig Tillite and the boulder beds in the upper parts of the Dalradian, it demonstrates a repeated glacial influence during Neoproterozoic and Early Palaeozoic times.

References



(Figure 5.25) Map of the area around the Kinloch Laggan Road A86 GCR site. After Robertson and Smith (1999). The wider geological setting is shown on (Figure 5.18). KLS, Kinlochlaggan Syncline.



(Figure 5.26) Typical lithofacies of the Kinlochlaggan Boulder Bed with 40 x 16 cm granite boulder in centre of view [NN 548 897]. Hammer head is 16.5 cm long. (Photo: BGS No. P 221180, reproduced with the permission of the Director,

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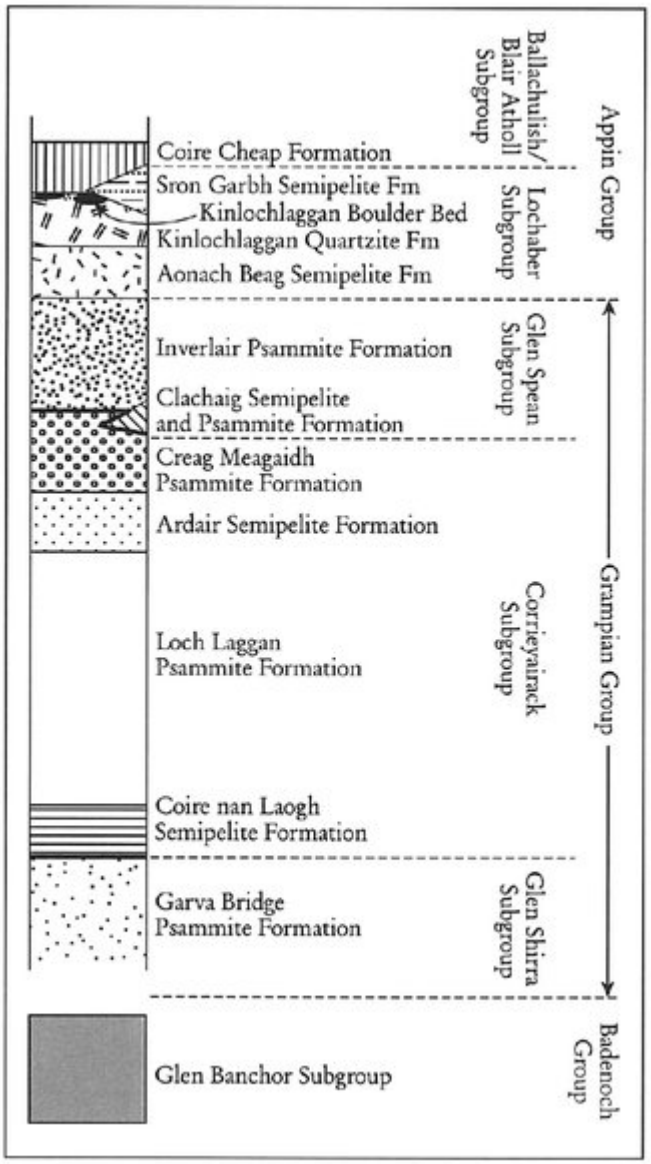

(Figure 5.27) Lithostratigraphy of the area within and west of the Geal-charn–Ossian Steep Belt in the vicinity of the Kinloch Laggan Road, Allt Mhainisteir and Aonach Beag and Geal-charn GCR sites. After Robertson and Smith (1999).