British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Progress Report on the Geology of 1:50 k Sheet 64W (Newtonmore)

IGSN Programme
Internal Report IR/03/048

Cross-bedding in psammite, within core of F2 fold (view to east); showing southward facing. Allt Bhran section [NN 76559 90129], Photo: P514833 (M. Krabbendam).

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Cross-bedding in psammite, within core of F2 fold (view to east); showing southward facing. Allt Bhran section [NN 76559 90129], Photo: P514833 (M. Krabbendam).

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Foreword

This report is intended to summarise and capture the results and provisional interpretations which stem from the 2002 mapping season in 1:50 000 Sheet 64W (Newtonmore). The north-west part of the sheet has been completely revised at 1:10 000 scale for both solid and superficial geology. The remainder of the sheet has been completely revised for the superficial geology along with rapid traversing and reconnaissance mapping for the solid. That area will be clean copied at 1:25 000 scale only.

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TABLE

Table 1 Suggested stratigraphical correlation for Sheet 64W (Newtonmore) and the surrounding area. Note that the Allt na Biorag Psammite Formation in NN69SE may equate with the lower part only of the Gaick Psammite Formation.

Summary

This report describes the results of solid geology fieldwork in 1:50 000 sheet 64W (Newtonmore) resulting from the 2002 summer mapping season. A full revision of the solid geology at 1:10 000 scale was completed in the north-western part of the sheet (Sheet NN69SE) while rapid mapping/reconnaissance of the solid geology has been carried out in the remaining 85% of the sheet area The superficial geology of the sheet has been completely revised and will be described in a separate report.

The north-western part of the sheet contains the transition from the deeper water graded sandy and silty turbidite deposits of the Corrieyairack Subgroup upwards (and south-eastwards) into the shallow water sand-dominated deposits of the Strathtummel Subgroup. East of the A9 trunk road, the Gaick region is confirmed as a single lithostratigraphical package in the Strathtummel Subgroup recording shallow water depositional conditions, greatly thickened by D2 recumbent folding. Axial surfaces of these folds dip gently east overall with gently east plunging to sub-horizontal fold axes. Axial traces are generally N-S trending. The main regional (biotite) schistosity is axial planar to these folds and locally, can be seen clearly deforming an earlier bedding near-parallel biotite fabric. The available evidence for stratigraphical younging is limited to a few well-washed river sections but shows that regional facing is always to the south in S2 across the Gaick region. No large-scale F1 folds are recognised with the exception of those at Crubenmore on the A9. Minor undulations of the main regional fabric mean that the sheet dip varies between gently north to gently east across open upright north-east-plunging folds, in marked contrast to the conspicuous pattern of reclined, north-west verging D3 folds deforming the main regional (S2) schistosity in Glen Truim and farther north-west. There appear to be no other major fold sets across this part of the Gaick region The Drummochter Dome thus takes the form of a stack of recumbent D2 folds, modified by steep zones to the north-west (Geal Charn-Ossian Steep Belt) and south-east (Tummel Steep belt and correlatives). The pattern of early recumbent folds and later steep belts is similar to that seen in the higher structural levels south of the Boundary Slide which include the Tay Nappe.

1 Introduction

This report covers the results of field mapping of mainly solid geology in the 2002 summer season in the Newtonmore district (1: 50 k Sheet 64W) of the Central Highlands, (see areas outlined in Figure 1). The aim the resurvey has been to acquire knowledge of the geology and its structural relationships to the surrounding sheets (Figure 2) to enable compilation of Sheet 64W in the 2002/03 project year alongside completion of 64E (Ben Macdui). To that end, 1:10 000 scale mapping (Sheet NN69SE) has completed a full revision of the solid geology in the north-western part of the sheet while rapid mapping/reconnaissance of the solid geology has been carried out in the remaining 85% of the sheet area. From a total of 58 field days, 38 were utilised in rapid/reconnaissance solid mapping of approximately 300 km^2 of ground (AGL + MK), the remainder in detailed 1:10 000 work (RAS) in NN69SE and adjacent ground. Clean copies will be prepared at 1:10 000 scale for areas mapped in detail, 1:25 000 for the remainder of the area.

In addition, J. Merritt and N. Golledge completed 125 km^2 mapping of the superficial deposits in the central Gaick region and in Glen Feshie. The superficial geology of the sheet is now completely revised (see various progress reports). A solid and superficial database now exists for the entire 1:50 000 sheet with the exception of a few days solid reconnaissance work remaining in the south-west of the area.

This work completes the solid revision for much of the A9 corridor and the ground between Dalwhinnie, Newtonmore and Kingussie. In essence this comprises the area to the north-west of the Ericht-Laidon Fault and covers an area of complex lithostratigraphical and structural relationships within and between rocks of the Corrieyairack and Glen Spean subgroups and the Glen Banchor succession. To the south-east of the Ericht-Laidon Fault and across the remainder of the sheet, the Gaick plateau (Gaick Forest) and the slopes south to Glen Garry and the A9 (Forest of Atholl) have been reconnoitred to confirm the lithostratigraphical and structural context of the solid geology. Relationships adjacent to the Boundary Slide (Treagus 2000) and linkages with the Grampian Group basin architecture exposed north-west of the Geal Charn-Ossian Steep Belt (Smith *et al.* 1999) can be extrapolated into the Gaick region. Lithostratigraphy in the Gaick region has been previously correlated with the shallow water Strathtummel succession (Thomas 1980) and may be broadly equivalent to all or parts of the Atholl and Strathtummel subgroups defined on the adjacent Sheet 55W (Schiehallion), (Treagus 2000) and Sheet 64E (Ben Macdui), (BGS in prep.). North-west of the Ericht-Laidon Fault, shallow water conditions are characteristic of rocks of the Glen Spean Subgroup, following on from the deeper water turbiditic deposits characteristic of the Corrieyairack Subgroup.

1.1 NEW 1:10 000 COVERAGE : GLEN TRUIM DISTRICT - SHEET NN69SE (CRUBENMORE) AND ADJACENT AREAS: (RAS)

R A Smith mapped the solid geology around Glen Truim (see Figure 1). The quaternary geology had been separately by J. Merritt and N. Golledge (see progress reports by those authors). 1:10 k mapping of the solid geology concentrated on the ground around Crubenmore, Glen Truim and the A9 trunk road. Exposure is relatively good and there are several craggy hills in the area, the highest of which is Cruban Beag at 590 m OD. Mapping Sheet NN69SE and the adjacent area to the east (part of NN79SW) aimed to unravel a coherent lithostratigraphical and structural story despite the fact that two major faults cross the area, namely the Ericht-Laidon, and Glen Truim faults. The possibility of correlating the solid geology across these faults was to be tested and so further analyse the basin architecture and lithostratigraphical framework of Smith *et al.* (1999). In particular, it was hoped to identify the proposed shelf break marking the change from deeper to shallower water deposits, believed to lie south and east of the Corrieyairack depocentre.

S. Robertson had revised the area to the north of NN69SE and had, in that process, mapped the north-west corner of NN69SE, linking the lithostratigraphy there with that exposed farther north-west around Newtonmore. From the previous mapping (Smith *et al.* 1999) it was known that metasedimentary rocks of the Corrieyairack Subgroup (Grampian Group) occupy the area to north-west of the faults, whereas the rocks to the south-east were regarded as broadly equivalent to Glen Spean Subgroup (=Strathtummel Subgroup?). It was an objective of the resurvey to confirm whether the two subgroups were in faulted contact or whether the Corrieyairack passed upwards and/or laterally into the Glen Spean/Strathtummel Subgroup. In general the Corrieyairack Subgroup is characterised by turbiditic facies with alternation of psammitic and semipelitic formations whereas the Strathtummel Subgroup is a shallower water quartz-rich psammitic succession. In places, where the exposures were clean, way up structures and bedding/cleavage relationships could be ascertained. These were critical to building up a lithostratigraphy and determining the facing of the fold phases.

1.2 NEW RAPID/RECONNAISSANCE MAPPING AND STRUCTURAL TRAVERSING IN THE GAICK REGION : (MK AND AGL).

The high ground between Glens Truim, Tromie, and Feshie, the extensive and remote higher plateau comprising the Gaick Forest, and the south-facing slopes and glens extending into the Forest of Atholl along the southern margin of the Sheet (see Figure 1) were covered by reconnaissance mapping and structural traversing. Much of the high ground on the Gaick Forest plateau lies between 850 and 950 m O.D. The plateau is bisected by the N 010° trending defile extending along the valley of the Edendon Water in the south of the Sheet, through Loch an Dùin and Loch an t-Seilich and continuing along Glen Tromie to merge with the Spey valley at Tromie Bridge [NN 790 995].

The various stream sections provide variable levels and quality of exposure, the upland plateaux are mainly heather and peat-covered and are frequently devoid of any useful solid exposure other than regolith. The area is dominated by psammitic metasediments which generally lack visible way-up indicators, in part due to the dearth of clean-washed exposure, in part to the strain state. Good sections do exist downstream from some of the Hydro-scheme tunnel intakes (see details below). The main aim was to establish the uniformity or otherwise of the lithostratigraphy and to gain a working knowledge of the structural architecture to enable construction of coherent profiles between the Boundary Slide region to the south-east and the Geal Charn-Ossian Steep Belt (Glen Banchor High/Kinlochlaggan Syncline) in the north-west.

The solid geology of the Gaick region is confirmed as a single lithostratigraphical package, albeit greatly thickened by the effects of D2 recumbent folding, recording shallow water depositional conditions. Axial surfaces of the main D2 folds dip gently east with gently east plunging to sub-horizontal fold axes. Axial traces are generally N-S trending. The main regional (biotite) schistosity is axial planar to this fold architecture. In semipelite, that axial planar fabric can clearly be seen to deform an earlier near-bedding parallel fabric defined by preferred parallel orientation of biotite and a grain shape fabric in quartz and feldspar. On this basis the main regional (biotite) schistosity is taken as S2, and thus consistent with neighbouring areas in the Central Highlands. The earlier fabric in semipelitic lithologies is presumably S1 (or combined S1/S0 in places). Minor undulations of the main regional fabric mean that the sheet dip varies between gently north to gently east across open upright north-east -plunging folds. There appear to be no other major fold sets across this part of the Gaick region in marked contrast to the conspicuous pattern of reclined D3 folds deforming the main regional schistosity in Glen Truim and farther north-west. The Garry Fault extends across the region from the south-west corner of Sheet 64W along the Allt Coire Mhic-sith, passing just south of Gaick Lodge [NN 757 848], to the Cairngorm granite complex where it may control and/or locally displace the granite margin just south of Loch Einich (Sheet 64E) [NN900 965]. Normal faults coincide with the prominent

north-south topographic feature of the Gaick valley and of Loch an Dùin. Many of the minor intrusions present in the region are concentrated along this fault system.

2 Lithostratigraphy of Sheet 64W (Newtonmore)

The lithostratigraphy is dealt with here in the tracts north-west and south-east of the Ericht-Laidon Fault and then for the remainder of the Gaick region south and east towards Glen Garry. The transition from deeper water turbiditic to shallower water shelfal lithofacies can be traced across the north-west and northern part of the sheet, by means of a prominent unit of semipelite and quartzite/quartzose psammite with separate distinctive packages of psammite and micaceous psammite above and below. Correlation of the mapped formations from each of the principal areas of investigation is presented in Table 1.

2.1 NORTH-WEST OF THE ERICHT-LAIDON FAULT

Lithostratigraphy north-west of the Ericht-Laidon Fault can be matched with that erected farther north by Cavill, Highton and Robertson on Sheet NN69NE (BGS, 1999). On NN69NE, to the west of the Glen Truim Fault, the Creag Dhubh Psammite Formation lies stratigraphically above the Torr na Truim Semipelite Formation in a syncline whose axial trace trends north-north-east – south-south-west. Both formations are placed within the Corrieyairack Subgroup although exact correlation with the type areas farther west is not certain. Smith *et al.* (1999) correlated the Torr na Truim Semipelite Formation with the Ardair Semipelite Formation and the Creag Dhubh Psammite Formation was correlated with the Creag Meagaidh Psammite Formation of the Dalwhinnie district. East of the Glen Truim Fault the Raliabeg Psammite and the Ordan Shas Psammite were considered to have uncertain stratigraphical positions. In the north-west corner of sheet NN69SE a small area of 'basement' Glen Banchor succession bounded by a fault to the east and a ductile slide to the south is inferred from adjacent 1:10 k mapping but not exposed.

On Sheet NN69SE, the Torr na Truim Semipelite Formation and Creag Dhubh Psammite Formation can be traced south-west and appear to be overlain by a further semipelite and in turn by micaceous and quartzose psammites including calc-silicate lenses. These formations are reasonably well exposed in a synclinal structure on Meall Ruigh nam Biorag [NN656 905], and pass westwards into the Fara Psammite Formation of Sheet 63E (Dalwhinnie).

The extensive outcrop of the Creag Dhubh Psammite Formation appears to be due to folding; its true thickness is much less. Younging in graded beds close to its margin with the adjacent Torr na Truim Semipelite Formation confirms that the psammite stratigraphically overlies the semipelite. The base of the Torr na Truim Semipelite Formation is not seen on this sheet as it is displaced by the Glen Truim Fault.

2.1.1 Torr na Truim Semipelite Formation (= Ardair Semipelite Formation)

This formation had already been mapped and recorded on NN69NE as being dominantly schistose semipelite although locally gneissose in part. Thickness is estimated as ≥ 750 m. Subordinate thin psammite and micaceous psammite bands and intercalations of finer grained quartzose semipelites are common. Fine-grained psammite bands 1-2 cm thick occur in several outcrops. Psammite bands become thicker towards the top of the formation but the junction with the overlying Creag Dhubh Psammite Formation is not exposed. Where schistose semipelite is present, muscovite and biotite are common together with quartz and feldspar porphyroblasts. Small garnet porphyroblasts occur mainly in the more quartzose bands. Locally a coarse S3 crenulation cleavage is developed in the more schistose semipelite. In the forested area south and east of Mains of Glen Truim [NN 680 944], craggy outcrops of semipelite are commonly gneissose with small quartz and plagioclase segregations in a biotite-muscovite-quartz- feldspar

± garnet matrix. The semipelitic gneiss is possibly preferentially exposed as it tends to be massive. Pale pink to white granitic pegmatite sheets and lenses are commonly intruded into the formation, quartz lenses and thin (migmatitic?) segregations are also present.

2.1.2 Creag Dhubh Psammite Formation (= Creag Meagaidh Psammite Formation)

The Creag Dhubh Psammite Formation crops out extensively on Sheet NN69SE between Cnocan na h-Oidche Uvie [NN 668 947] in the north to Am Binnein [NN 667 910] in the south where it is displaced by the Ericht-Laidon Fault. The junction with the Torr na Truim Formation in the southern area is not well exposed and the junction is inferred from the mapping to the north. In the north the formation is defined as a grey psammite with micaceous psammite layers showing grading to thin schistose semipelite tops. Units in which semipelite was more abundant than psammite and units of interbedded psammite and semipelite were mapped on NN69NE. The overall thickness for the formation is estimated to be 700 –1000 m.

North-east of Creag a' Chrubain [NN 676 931] the lowest exposed beds are grey flaggy fine-grained psammites 1-5 cm thick, with thin micaceous psammitic to semipelitic partings. These are locally seen to be graded beds with semipelitic tops. The semipelitic fraction is generally less than 1 cm thick and only rarely are bands or lenses up to 10-20 cm thick. Minor thin fine-grained calc-silicate lenses are also present.

Farther west up-slope, psammites with individual beds 10-40 cm thick are common; exceptionally the beds reach 70 cm thick. Amalgamated psammites up to 6 m thick are inferred, probably indicating channelled deposits. Beds generally dip moderately westwards but changes in younging direction indicate that tight to isoclinal folds with wavelengths of 400-500 m are present. Apart from the grading, little else in the way of primary sedimentary structure can be seen due to lack of clean exposures and the effects of deformation. Some beds are flexed around boudinaged quartz vein boudins or quartz-felspar pegmatite lenses.

2.1.3 Creag na Sanais Semipelite Formation

The Creag na Sanais Semipelite Formation is exposed on Meall Ruigh nam Biorag [NN656 905] and the knolls to the east. It extends north of Creag na Sanais [NN 654 923] and, farther north, may be displaced (and disappear?) across the northerly trending Creag Liath Fault.

The base of the Creag na Sanais Formation is marked by more coherent gneissose semipelite. It directly overlies thinly interbedded quartzose psammites and micaceous psammites and semipelites which appear to lie at the top of the fairly homogeneous Creag Dhubh Psammite Formation [e.g. at NN 6561 9235 and farther south at NN 6579 9152]. The semipelite is a brownish grey gneissose rock, coarsely foliated in places, but with thin fine-grained biotitic and quartzose psammite beds with scattered garnets. The semipelitic gneiss contains elongate quartz and feldspar porphyroblasts wrapped by the biotite and muscovite-dominated foliation. The top of the semipelite is apparently interbedded with micaceous (biotite) and quartzose psammite. This uppermost semipelite 'member' is only about 100 m thick, but appears thicker east of Meall Ruigh nam Biorag due to repetition in steeply overturned F3 folds. Mapping indicates that the semipelite is offset by minor faults trending ENE south of Creag na Sanais.

2.1.4 Allt nam Biorag Psammite Member

The Creag na Sanais Semipelite Formation (see 2.1.3) is succeeded on NN69SE by feldspathic psammites, including distinctly quartzose psammites associated with calc-silicates and including cross-bedded units. Semipelitic and micaceous psammite beds up to 0.5 m thick are also present.

The stratigraphical position of the Creag na Sanais Semipelite Formation is at present uncertain, two potential models exist. It is possible that the formation could be correlated with the Mashie Semipelite Formation on Sheet 63E (Dalwhinnie) to the west and that the overlying more mixed

quartzose succession correlates with part of the Fara Psammite Formation mapped above the Mashie Semipelite Formation on Sheet 63E. In draft descriptions of the Dalwhinnie Sheet, it has been suggested that the Fara Psammite might be equivalent to the Creag Meagaidh Psammite Formation (Creag Dhubh Psammite Formation). However the lithologies are not generally typical of the turbiditic Creag Meagaidh Psammite Formation and in places more easily match shallow water Glen Spean/Strathtummel Subgroup lithologies. On NN69SE the quartzose psammites lie above both the Torr an Truim Semipelite Formation and the Creag na Sanais Semipelite Formation. As the Mashie Semipelite Formation lies directly on Glen Banchor succession rocks on Sheet 63E, it would perhaps be regionally more consistent (c.f. Robertson and Smith 1999) to retain Mashie Semipelite Formation (and Torr na Truim Semipelite Formation) as equivalent to the Ardair Semipelite Formation.

The Creag na Sanais Semipelite Formation marks the transition from deep water turbiditic to shelfal lithofacies which occurs above the Creag Meagaidh Psammite Formation, (= Clachaig Semipelite Formation of the Glen Roy/Loch Laggan district). This would imply that the Creag na Sanais Semipelite Formation may be unexposed in low ground west of the Strathspey granite; possible correlatives do however occur in ground to the south (e.g. on both sides of Loch Ericht around [NN 585 820] and farther south-east, e.g. around [NN 615 765]. Graded turbiditic units are present south-west of Balsporran Cottages in Allt Coire Fhar [NN 6176 7858], (Creag Dubh Psammite Formation?). Sections in this and surrounding streams appear to pass out from Corrieyairack Subgroup through semipelitic and quartzose psammite lithologies (= Creag na Sanais Semipelite Formation and Allt na Biorag Psammite Member? of NN69SE). Such a correlation then raises the possibility that the Creag na Sanais Semipelite Formation should be regarded as equivalent to the Phones gneissose semipelite on the south-east side of the Ericht-Laidon Fault, (see Table 1 and further discussion below). The Creag na Sanais Semipelite Formation and Allt na Biorag Member would correlate with part of the Fara Psammite Formation. Resolution of the models will require some re-investigation of the Fara Psammitte Formation in Sheet 63E (Dalwhinnie).

2.1.5 Raliabeg and Ordan Shios exposures

The A9 road cuts south of Newtonmore [NN 71 97] and near Raliabeg [NN 697 966] provide good exposures in the uppermost parts of the Corrieyairack Subgroup. At Raliabeg, the psammitic rocks are thin (cm-scale) bedded, have a planar lamination and commonly have graded tops with thin (<1cm) semipelitic interbeds. Sheet-like quartzites occur within the psammite heralding the change to the Gaick Psammite Formation. This psammite unit is regarded as a lateral equivalent to the Creag Meagaidh Formation (Corrieyairack Subgroup). On Ordan Shios [NN 715969], pale coloured, quartzose to alkali-feldspathic psammite preserve many sedimentary structures including slumped lamination, small-scale channels with lateral accretion surfaces, convolute lamination and planar lamination. No grading occurs. The quartzose nature and the sedimentary structures suggest a shelfal succession and thus these sequences are assigned to the Glen Spean Subgroup. The lower boundary of these shelfal psammites can be constrained in the ground south of the Raliabeg and Newtonmore between Ordan Shios and Creagan a Choin [NN 704958] to the A9.

2.2 SOUTH-EAST OF THE ERICHT-LAIDON FAULT

Younging evidence and a partial repetition of psammites about an anticlinal fold core [NN 685 918] of thin psammites, quartzites, and semipelitic and pelitic schists, indicate that the Strathtummel Subgroup overlies a succession of intercalated flaggy fine-grained biotite-bearing psammites, micaceous semipelites and pelites. These units are transitional upwards from the Corrieyairack Subgroup. One problem with this interpretation is that the distinctive but ?impersistent gneissose biotite-rich semipelite which lies on the south-east side of the fold core is absent from the north-west limb. If this anticlinal fold plunges north-east then a fine-grained

flaggy psammite may lie in the core to the west near Torr na Cuile Riabhaich. The best section through the lithostratigraphy is along the A9 road cut at [NN 678 907 to NN 678 914].

2.2.1 Etteridge Lodge Psammite and Pelite Formation (= Creag Meagaidh Psammite Formation)

In a belt from south of Etteridge Lodge [NN 685 923] across to Allt Phoineis [NN 706 936], interbanded fine-grained psammites, micaceous psammites and schistose semipelites and pelites lie to the north-west of the Falls of Phones semipelite (see below). Biotite is common in the psammites whereas muscovite (+ biotite) appear to dominate the semipelites and pelites; small garnets are present locally. Pale calc-silicate bands are rare. The psammites tend to be flaggy and planar bedded, commonly between 5 and 20 cm thick. Younging indicators on Creagan Mor [NN 7011 9347] and in the Falls of Phones semipelite to the south-east suggest that these interbedded psammites and pelites lie in a fold core. The Falls of Phones semipelite is not recognised on the north-west limb; here, there are intercalated quartzites, psammites and micaceous semipelites similar to the lithologies exposed at the base of the Strathtummel Subgroup. Farther to the north-west, small outcrops of grey fine-grained psammite with thin semipelite interbeds may correlate with the bulk of the Strathtummel Subgroup. The pinkish brown weathered fine-grained psammites west of Torr na Cuile Riabhaich [NN 6805 9168] may be lateral equivalents or lie below the interbedded psammites and pelites in an F2 anticlinal fold core.

2.2.2 Feshiebridge Psammite Formation (= Creag Meagaidh Psammite Formation)

Graded psammite, laminated psammite and micaceous psammite with bands of semipelite are present in the north-east part of Sheet 64W and mark the southward continuation of the turbiditic rocks exposed at Feshiebridge [NH 852 043]. The outcrop of these rocks extends south-west into Gleann Chomhraig with good exposures on Creag Dhubh [NN 824 997] and Creag na Sroine [NN 840 969]. The latter provides a good section through the upward change from graded (turbiditic) psammite (Feshiebridge Psammite Formation) through semipelite (10-15 m) into quartz-rich psammite and quartzite (20 m) and laminated psammite and micaceous psammite, the latter typical of the Strathtummel Subgroup psammite succession in the Gaick Forest region and taken as Gaick Psammite Formation. The same change can be seen in the inverted sequence on Croidh-la [NN 775 953] above and east of Glen Tromie, as well as in the hinge area of the south-facing recumbent anticline [NN 79 92] which lies between these two hills. This transition can be correlated with the passage upwards through the Falls of Phones semipelite into the Strathtummel Subgroup (see 2.2.4 below).

2.2.3 Falls of Phones Semipelite Formation (= Clachaig Semipelite Formation?)

This distinctive formation extends from Allt Phoineis [NN 7075 9334] south-westwards to the A9 cutting at Crubenmore and across the A9 to [NN 6719 9072]. It is a somewhat massive biotite-muscovite semipelite with sparse garnets. The fabric is generally rather coarse-grained and gneissose, but locally schistose. It contains local channels of cross-bedded biotite-rich psammite, indicating younging to the south-east into the quartzitic psammites and quartzites at the base of the Strathtummel Subgroup, (see below). Sincethis semipelite is taken as locally marking the change from turbiditic to shelfal depositional settings, correlation with the Creag na Sanais Semipelite Formation is regarded as sound, both formations can be taken as the local base of the Strathtummel Subgroup (= Glen Spean Subgroup, see Table 1). The Clachaig Semipelite Formation is distinctive both geochemically and magnetically and may represent a restricted environment occurring in the basal part of the Glean Spean Subgroup.

	L.Laggan – Steep Belt	Dalwhinnie	NN69SE & surrounding area		Gaick Forest – Feshiebridge	Schiehallion District, Sheet 55W
Glen Spean Subgroup	Inverlair Psammite Formation	Fara	Allt na Biorag Psammite Member	Gaick Psammite Formation	quartzite and quartzose psammite	**Strathtummel Subgroup** - *including* Bruar Psammite Formation
	Clachaig Semipelite	Psammite	Sanais Semipelite	Falls of Phones Semipelite	'Glen Tromie semipelites'	
Corrieyairack Subgroup	Creag Meagaidh Psammite Formation	Formation	Creag Dhubh Psammite Formation	Etteridge Lodge Psammmite & Pelite Formation	Feshiebridge Psammite Formation	
	Ardair Semipelite Formation	Mashie Semipelite Formation	Torr na Truim Semipelite Formation			

Ericht-Laidon Fault

Table 1. Suggested lithostratigraphical correlation for the Grampian Group in Sheet 64W (Newtonmore) and the surrounding area. Note that the Allt na Biorag Psammite Member in NN69SE may equate with the lower part only (quartzite and quartzose psammite) of the Gaick Psammite Formation.

2.2.4 Other Semipelite and Quartzite – Linking Glen Tromie to Falls of Phones

If the correlation referred to above can be extended to include the Creag na Sanais semipelite then constraints can be placed upon the stratigraphical succession across the Ericht-Laidon Fault. Critical exposure of this transition is limited in the ground between Glen Tromie and Glen Truim - the following observations were recorded.

In the River Tromie section between gridline 98 N and Tromie Bridge, semipelite accounting for between 10 and 50% of outcrop is intermittently exposed (MK 340-347). Semipelite is interbedded with psammite on a decimetre scale, with individual exposures of up to 5 m of semipelite. At the southern end [NN 786 979], quartz-rich psammite lies structurally beneath the semipelites. Bedding dips gently (10 – 20°) to the north making the structural/stratigraphical position of this semipelite-bearing sequence somewhat enigmatic. The quartzose psammite to semipelite and psammite sequence dips underneath the ?graded (?turbiditic) psammites at Tromie Bridge. If the semipelite is equivalent to the Creag na Sanais semipelite/Falls of Phones Semipelite, this would suggest an inverted sequence as seen on Croidh-la on the west side of Glen Tromie. However, minor F2 folds show a southerly vergence which would suggest a locally right-way-up sequence in this part of the River Tromie section when regional southerly facing is taken into account (see further discussion in Section 3.1.2). The psammite outcrops at Tromie Bridge [NN 789 996] may lie in a hinge zone, both northerly and southerly vergence was noted on S2/S0 relationships here and so it may be necessary to track the marker semipelite and quartzite sequence across the traces of large (km?) scale D2 folds of a similar geometry to that inferred farther south in Glen Tromie around [NN 759 905].

Semipelite is exposed over a structural width of 15-20 m in the Burn of Ruthven [NN 767 995] and probably north of the Ericht-Laidon Fault, thus somewhat isolated from other sections in this area. Pale grey weathering semipelite contains biotite, muscovite, quartz ± K-feldspar and carries two fabrics, with anastomosing crenulation fabric. No psammites are exposed locally.

There is clearly a passage upwards from turbiditic deep-water depositional environment through progradational semipelite and quartzite into sustained shallow-water, shelfal depositional conditions. In Sheet 64W the various elements of this change are distributed across the Ericht-

Laidon Fault and provide a mappable boundary across the northern part of the map, such reconstructions would imply that disruption on the Ericht-Laidon Fault may not be great in this area.

2.2.5 Gaick Psammite Formation (=? Inverlair psammite Formation)

In the tract south-east of the Ericht-Laidon Fault, the Strathtummel Subgroup is represented by a thick sequence of predominantly grey fine-grained quartzose psammite with scattered biotite flakes and laminae in which biotite is concentrated. Some darker grey micaceous psammite interbeds are richer in biotite and also have muscovite on partings. Calc-silicate lenses are also present, e.g. near Meall Odharaich [NN 689 903]. Most of the bedded units are about 10 cm thick ranging up to 50 cm, and more rarely, 1 m thick. Locally cross-bedding is observed, marked by the biotite laminae, particularly in the clean sections seen in the southern part of the Crubenmore road-cut. Towards the base of the thick Strathtummel Subgroup, thin quartzites and quartzitic psammites associated with thin schistose to gneissose semipelites are exposed just above the Falls of Phones semipelitic gneiss, [e.g. at NN 6977 9243 and NN 6716 9061]. They lens out along strike and were not located in the A9 cutting in a section with abundant pegmatitic granite intrusions. Towards the Ericht-Laidon Fault, these Strathtummel Subgroup rocks are locally flaggy, feldspars are altered and reddened.

Farther south and east across Sheet 64W, laminated and/or thinly banded feldspathic psammite, quartzose psammite and micaceous psammite dominate the Gaick plateau region. There are minor amounts of quartzite and semipelite. Calc-silicates are rare. The most informative, i.e. cleanest washed, sections are to be found downstream from intakes in the region's hydroelectric scheme and have proved critical when assessing stratigraphical/structural linkages and regional facing. The best examples occur in the Allt Bhran [NN 77 89] and in Allt a' Chama Choire/Edendon Water [NN 71 79]. A further section in Allt a' Choire Bhig [NN 776 720] provides linkages south into Sheet 55W (Schiehallion).

The psammites are typically bedded on a 10 to 30 cm scale but with mm-scale internal laminations defined by compositional colour banding (variations of quartz vs. feldspar) and/or fine lamellae of biotite. Psammites typically have <5-10% biotite, micaceous psammites have 10-20% biotite. Colour variations range from pale-grey to mid-grey with increasing biotite content, and micaceous psammites commonly appear speckled. Quartz-rich psammites appear very pale grey and are normally essentially mica-free. Some sections may give the appearance of grading (e.g. 'up' into more micaceous material) but can often be seen to grade 'both ways' within adjacent layers. Hence grading cannot be used to define way-up as it is in the turbiditic Corrieyairack Subgroup lithofacies generated by turbidity currents. Reliable way-up indicators were only rarely preserved in the sections examined, typically trough cross-bedding or ripple lamination; in general exposures are not clean enough to provide this level of detail, even where the strain state is not especially high. In a few cases, sands appear to lose mica content upwards in the same direction as indicated by ripples or cross-bedding. The evidence points to shallow-water depositional conditions with some current-winnowing of sediments. Estimates of the thickness of these shallow-water deposits must take account of the architecture of F2 folding across the Gaick but they probably only totalled 1 to 2km in depositional thickness.

The succession exposed across the Gaick Forest and Forest of Atholl can readily be correlated with the (undivided) Grampian Group rocks in the north-west corner of Sheet 55W (Schiehallion). Nothing to rival the quality of exposure preserved in the A9 Stalcair Cut or the River Garry (Treagus 2000) has been seen in the Gaick region. Nevertheless, the general character and range of features are consistent with those undivided Grampian Group rocks (?equivalent to Strathtummel Subgroup and designated as such on the adjacent Sheet 64E). The succession may link with the area extending south-west towards Loch Errochty and Glen Lyon on the western flank of the Schiehallion "Twist". It has not been possible to map any separate formations as in Strathtummel on Sheet 55(W) (the Strathtummel Subgroup). Rocks in the south-

east of Sheet 64W (Dalnamein Forest area and upper Glen Bruar) would readily extend the Bruar Psammite Formation north-east from Sheet 55W given the apparent lack of any discrete quartzite or quartzose psammite formations.

It is confirmed that the high strain nature of the Dalnacardoch Banded Zone (DBZ) makes correlations across any north-eastward continuation of the DBZ tenuous at best, c.f. Treagus (2000). The Atholl and Strathtummel Subgroups (including the south-east part of Sheet 64W) may represent a separate lithostratigraphical package separated by high strain (a thrust??) from the package to the north-west in the Gaick Forest and Upper Glen Garry.

3 Structure

3.1 DUCTILE DEFORMATION

The nature of the ductile fabrics and fold architecture developed in much of the Gaick region is relatively simple, in part due to the dominantly psammitic nature of the succession. These rocks show little otward sign of having been subject to such a high degree of non-coaxial simple shear as those around the Boundary Slide and farther south. Planar S fabrics dominate; with the exception of intersection lineations (S2 on S0 or vice versa) and/or F2 fold hinges there are no widely developed L fabrics, e.g. conspicuous mineral or rodding lineations, apparent on S0 or S2. The degree of co-axial flattening strain may have been considerable, the best preserved cross-bedding occurs in hinge zones, elsewhere on folds limbs original bedding features have not been readily identified. Only hints of convergence of compositional laminae are seen in places. Regional facing is typically (gently down) to the south. The D2 structure only appears significantly modified (by D3 folding and fabrics) in the north-west part of the Sheet towards the Glen Banchor ‘high’, and suggests that buttressing against this basement feature (Robertson and Smith 1999) is a significant factor south-east of Glen Truim also.

3.1.1 D1

This earliest phase of folding has only been recognisedin the well exposed section on the A9 cutting east of Crubenmore Lodge [NN 678 916]. Here isoclinal minor folds with weak axial planar fabrics are refolded by the main recumbent F2 folds carrying the main regional foliation, S2. Locally a recumbent refolded F1 has a horizontal hinge trending 103°N, but interference patterns in the outcrop show that the F1 folds have curvilinear axes. No major F1 folds or shear zones have been identified in this area but an early ductile shear has been inferred between the Glen Banchor Complex and the Corrieyairack Subgroup on Sheet 63E.

No D1 folds have been observed or constrained elsewhere in the Gaick region. Occasionally however, and typically in more semipelitic lithologies (see Figure 3), the S2 fabric (see 3.1.2 below) clearly crenulates an earlier biotite fabric (S1). The latter occurs as a “bedding-parallel” fabric (typically stubby prismatic biotite 0.5 mm or less in length) but can on occasion be seen oblique to bedding, associated with a grain-shape fabric in quartz, and clearly tectonic in nature. When best seen, e.g. in semipelite at NN 79002 99326, small angles between S1 and S0 are preserved (northerly vergence on S1) and S2 can be clearly seen to crenulate S1 (southerly vergence on S2).

3.1.2 D2

The main regional fold phase is characterised by tight to isoclinal major to minor recumbent folds and is accompanied by the main penetrative foliation in the psammites although it appears as a tight crenulation cleavage in more pelitic intercalations (see 3.1.1 above).

In the Glen Truim district, tight to isoclinal minor folds are seen in several outcrops commonly as anticline/syncline pairs. Few large scale F2 folds are evident but from the change in way up and bedding/cleavage relationships, the presence of larger scale F2 folds can be inferred. The best sections are exposed along the A9 cutting at Crubenmore. The lithostratigraphy and gross structure of the area appears to have affected the development of the folds; smaller scale recumbent folds are more commonly developed in the banded turbiditic facies whereas stacks of recumbent neutral folds appear in the psammitic facies. The former are more affected by the subsequent F3 deformation but this may partly be due to its greater proximity to the Glen Banchor 'basement high' lying to the north-west. Pre-existing quartz veins (may be D1 or early D2?) and lenses are folded and rodded by D2.

North-west of the Ericht-Laidon Fault, tight to isoclinal minor folds are refolded by F3 and appear to be slightly upwards facing to the east (e.g. at [NN 6558 9263], loc^{n}. CNS 9). Within the Torr an Truim Semipelite Formation, recumbent F2 minor folds with a fine axial planar crenulation cleavage dipping about 10° SW, face slightly up to the south-east on the evidence of grading in thin psammite interbeds at [NN 682 940], (locn. MG3).

Younging evidence and a repetition of the quartzitic and psammitic beds characteristic of the base of the Strathtummel Subgroup indicate a major F2 fold lies in ground just to the south-east of the Ericht-Laidon Fault. The fold has a gently north-east plunging axis (to about 068°N). The S2 foliation in this area dips about 40° south-east, steeper than bedding on the right way up south-eastern limb (as seen at [NN 7002 9313], implying atypical northerly facing and possible re-orientation by D3 folding (or an earlier F1 fold?). The fold trace is intersected obliquely to the south-west by the Ericht-Laidon Fault. Farther south, and into the Strathtummel Subgroup, the S2 foliation is usually defined by a single biotite fabric which dips more gently (about 16-20°) south-south-east (south-facing here?). On Meall Odharaich [NN 6865 9043], stacked neutral recumbent F2 folds with near E-W horizontal hinges are present. Tight recumbent F2 folds south of Meall Odharaich [NN 6876 9009] have axes plunging 6° to 076°N.

Exposed sections west and east of the A9 between Crubenmore and Cuaich suggest that a large scale D2 antiformal syncline (Glen Truim Syncline?) whose axial trace runs south-west – north-east is present in that area, possibly linking with the closures observed on Meall Odharaich (see above). In Allt Garbh [NN 6765 8955], stacks of F2 decimetre-scale closures are marked by well-exposed hinges plunging at c. 10°N towards N 080°. Overall sense of vergence appears to be neutral or towards the north. Across Glen Truim in the quarries at [NN 6680 8932], a neutral to south verging stack of decimetre-scale F2 folds have axes that plunge c. 10° towards 262°N. The road-cutting north of Cuaich Farm [NN 6602 8771] contains a 200 m long section of recumbent F2 folds with axes plunging c. 10° towards N 270°. Overall fold vergence here is to the south. The expansive tract south of Allt Cuaich towards Carn na Caim [NN 675819] and A'Bhuidheanach Bheag [NN 661 776] has uniformly south facing S2 on S1/S0 and thus lies on the western lower limb of the antiformal syncline (Meall Chuaich Syncline?). The hinge of this syncline can be traced from the area north-west of An Dùn [NN 720 826] northwards to Creag Druim Gheallogaidh [NN 752 974] where the trace intersects the Ericht-Laidon Fault. The anticlinal trace which must lie between these two synclinal structures has not been observed directly but can possibly be inferred from measurements of dip and strike recorded by the previous (1913) survey. The trace would pass north-west of Creag Ruadh [NN 683886] and south-east of Leacairn [NN 656 846], see Figure 4.

Across the remainder of the Gaick region to the south and east, biotites define a discrete planar cleavage or schistosity in most psammite and micaceous psammite that typically makes a small angle with the compositional banding/ lamination. Systematic observation of the transection of this biotite fabric on 'S0' is nearly always possible and, together with identification of discrete hinge zones (e.g. Allt Bhran section [NN 765 903]), has been used to constrain a stack of recumbent F2 folds whose axial traces extend broadly N-S across the Gaick plateau. These, and

the other main F2 fold traces referred to above, are shown on the provisional geological map presented in Figure 4.

The F2 fold axial surfaces typically dip gently east and F2 fold axes plunge gently down-dip. Note that the F2 axial planes strike N-S rather than north-west – south-east and thus at high angles to the traditional north-east – south-west "Caledonian trend". This might suggest that the north-east – south-west "Caledonian trend" is more of a late 'D3' feature accentuated by superposition of the D3 Tummel/Cairnwell and Ossian Steep Belts on broadly horizontally stacked tectonostratigraphy (still preserved in the various 'flat belts', e.g. in the Tay Nappe).

Minor F2 folds are tight to isoclinal folds (Figure 5), but in parts have quite open rounded hinge zones with wavelengths of several metres (as on Creag an Loch [NN 72928 80304], see Figure 6). However, the hinge-zones of the regional F2 closures are, in these psammitic lithologies, more typically marked by stacks of tight F2 folds, with wavelengths of 0.5 m or less, often showing a good axial planar biotite fabric (see also Figure 5). Such hinge zones can be several 10's of metres thick, as in the Loch an Dùin syncline [NN 7292 8030] and in the Allt Bhran section [NN 770 897]. The limbs of the regional F2 folds are characterized by zones of moderately high-strain, with very straight laminations in psammite, showing only a very small angle between S2 and S0 and attesting to the overall tight to isoclinal nature of the F2 folds. Limbs can, in this way, be assigned to a general south- or north vergence; the location of hinge zones can thus be constrained by the occurrence of fold stacks and vergence changes.

Younging and hence facing evidence is best seen in the Allt Bhran section (Figures 7 & 8) in excellent exposures between [NN 772 896] and [NN 764 902]. The section contains many F2 folds, generally tight, and with fold axes plunging gently (10°–15°) to the east (N 085°–110°). The psammites show regular mm-scale laminations, clearly defining cross-bedding in a number of places. Cross-bedding preserved within a fold hinge (Figure 8) at [NN 76559 90129] indicates southerly facing on S2 and supports the combination of cross-bedding and local vergence relationships, which also indicates southerly facing on S2 elsewhere in this section. Southerly facing is also demonstrated in right-way-up graded (turbiditic) psammites at Feshie Bridge [NH 852 043], Creag Dhubh [NN 824 996] and Creag an Sroine [NN 838 970]. Elsewhere on the Gaick plateau we only see hints of stratigraphical way-up and must rely upon the almost ubiquitous preservation of the S0/S2 vergence relationships.

The overall structure of the 'Drummochter Dome' (Thomas 1979, 1980) appears thus as a south-facing stack of recumbent anticlines and synclines which can now be traced from structurally beneath the Boundary Slide (Sheet 55W) to the steep zone (D3 modifications) developed on the south-east flank of the Glen Banchor "basement high" (Sheet 63E (Dalwhinnie)) and Smith *et al.* 1999, Smith and Robertson 1999). The cross-section in Figure 4 aims to illustrate this structure prior to development of the D3 structures. Facing direction would be consistently south across the Gaick becoming south and down beneath the Boundary Slide towards Sheet 55W. The area south-east of Gaick Lodge (e.g. Allt Gharbh Ghaig [NN 78 82]) shows some evidence of minor upright open flexures of that D2 structure on north-east – south-west trending axes, otherwise the Gaick region appears relatively unmodified by such later ductile deformation.

Higher strain(?) rocks may extend across the south-east corner of the map in a north-north-east – south-south-west trending zone in which it becomes very difficult to determine S2 cleavage-bedding relationships (and hence F2 fold vergence) owing to the high degree of transposition. This may represent a continuation of the Dalnacardoch Banded Zone (DBZ, see Figure 4) from Sheet 55W (Schiehallion) (Treagus 2000), but will require further checking to be certain. It is tempting to extend this high strain zone along the western limit of Grampian Group rocks on the "Schiehallion twist" – merging with the Boundary Slide (*s.s.*) and thus coinciding with the stratigraphical omission in the Appin and Argyll Group Dalradian and the north-west limit of definition of the Atholl/Strathtummel Subgroups in the Bohespic region.

Note that examination of relationships across the trace of the Bohespic Antiform in Allt a' Choire Bhig [NN 778 718] and at the Allt Crom Cut on the A9 [NN 768 690] suggests that in

both cases the macroscopic folding is of D2 origin (c.f. Treagus 2000). It is the main mica fabric (S2) which changes angular relationships with respect to S0 across the exposed fold trace. At Allt Crom, crenulation of that fabric can be seen in the semipelitic unit which defines the folded S0 surface (shiny black surface in cut cleared of overlying psammite for stability). The crenulation is most prominent in thickened semipelite on the F2 hinge and appears broadly coplanar/coaxial with S2/F2. The presently shown Bohespic Antiform trace marks a zone? where later 'De' folding (Treagus, 2000) is conspicuous, but at Allt Crom and in Allt a' Choire Bhig the macroscopic folds are D2, antiformal (synclinal) at Allt Crom and synformal (anticlinal) at Allt a' Choire Bhig. This suggests possible problems of structural correlation south to north across the sheet boundary from 64W to 55W.

Note that the considerable thickness of psammitic metasediments (6-8 km) required in the geophysical models for this region (Smith *et al.* 1999, Figure 4) are consistent with the folding observed but do not require a great stratigraphical thickness to "fill the polygon". The geophysical modelling might readily be explained by a stack of recumbent folds developed within *c.* 1-2 km stratigraphical thickness of Gaick Psammite Formation.

3.1.3 D3

Open to close folds with overturned axial planes assigned to D3 are common in the Glen Truim area but vary in abundance and tightness; the major F3 synform passing through Creag Dhubh on Sheet NN69NE can be traced south-west on to the north-west side of Sheet NN69SE. A complementary anticline may be located in the poorly exposed ground east of the Glen Truim Fault (see Figure 4). Mapping on the south-east limb of the Creag Dhubh syncline structure, numerous minor F3 folds and an associated crenulation cleavage are seen in interbedded psammite and pelite lithologies. The axes generally trend north-east – south-west. In the north of this area the F3 axes plunge $\leq 20°$ to the north-east, but to the south they plunge $\leq 30°$ to the south or south-west. The folds generally have steep long limbs and shallowly dipping short limbs; axial surfaces dip moderately to steeply south-east in contrast to the gently ESE-inclined S0/S1 in the Gaick region. Both south-east and north-west verging folds are present and the overall geometry of the minor structures is consistent with the steep common limb of a D3 syncline-anticline pair, now displaced by faulting (see Figure 4). In semipelitic bands the axial planar, commonly widely-spaced, crenulation cleavage dips about 60° to 80° to the south-east. The crenulation cleavage is well seen in the Creag na Sanais semipelite east of Meall Ruigh nam Biorag. However, locally there appears to be fanning of the crenulation cleavage to dip up to 40° north-west. Near the summit of Am Binnein a large scale F3 culmination appears to be upright and plunging south-west.

In the Torr na Truim Semipelite near the Glen Truim Fault [NN 6828 9313] the crenulation cleavage developed in the semipelite bands dips 60° SE.

To the east of the Glen Truim Fault and the south-east of the Ericht-Laidon Fault, F3 is less evident. Here minor folds plunge at 10 to 20° to the west-south-west and are commonly open and upright. D3 appears to be more abundant (and with more commonly overturned axial surfaces) towards the north-west, possibly as the (F2) recumbent fold pile was pushed north-west over the Glen Banchor ' basement high'. To the south-east, in the Strathtummel Subgroup, D3 is less well developed creating open folds without an accompanying cleavage. The Ericht-Laidon Fault may thus disrupt an antiformal closure located in Glen Truim that is complementary to the Creag Dhubh synform. The minor folds referred to above thus lie on the common, steep limb of this fold pair.

3.2 BRITTLE DEFORMATION

Principal faults are illustrated on Figure 4.

3.2.1 Ericht-Laidon Fault

The northeast-trending Ericht-Laidon Fault is the main fault crossing sheet NN69SE, and is one of the major late-Caledonian sinistral strike-slip faults in the Grampian Highlands. The fault extends for about 170 km from the Tayvallich area where it has a dip-slip component of about 2 km. It was estimated that the fault has a sinistral displacement of about 7 km in the Moor of Rannoch (Hinxman *et al.*, 1923) area. Highton (1999) describes a variable sinistral offset along the fault but it appears to have decreased to approximately 1 km in the Grantown-on-Spey area and has not been recognised on the Knockando sheet to the north-east. The Ericht-Laidon Fault is not directly exposed in the area but exposures along the Allt a' Bhinnein [NN 6694 9100] show numerous minor faults and crush zones, which are associated with brittle fractured red granite veins. The fault is inferred to lie partly along the line of Allt a' Bhinnein and, to the east of the A9, along the length of Loch Etteridge. A subordinate synthetic fault with a similar north-easterly trend lies just to the west of Meall Odharaich [NN 6865 9039]. To the north-west, in Coire Mhoraich [NN 658 913] and south of Creag na Sanais [NN 656 920], minor north-easterly trending faults offset the Creag na Sanais semipelite sinistrally.

3.2.2 Glen Truim Fault

The Glen Truim Fault appears to be a complex fault zone, which forms a major splay on the north-west side of the Ericht-Laidon Fault, controlling the orientation of Glen Truim. Evidence for the Glen Truim Fault is exposed along the River Truim below the Falls of Truim [NN 6807 9230] where siliceous psammite flags are (probably antithetically) faulted and fractured in northerly and north-westerly orientations. The eastern branch of the fault is seen within psammites along the Glen Truim gorge east of Crubenbeg [NN 6833 9273] and is exposed in the east side of Poll Uaigh. This branch probably continues northwards to lie just west of the A9 roadcut at [NN 689 940] which exposes psammites with faulting including minor normal faults trending N044°. The western branch of the Glen Truim Fault Zone lies in the western meander of the River Truim [NN 683 931] where schistose semipelites strike into fine-grained siliceous psammites to the east of the meander belt.

The conjectural position of the Glen Truim Fault, as shown to the north on NN69NE, would appear to equate to the western branch of the Glen Truim Fault Zone. The extension of the eastern branch northwards may in fact form the inferred boundary between the Raliabeg Psammite and the Ordan Shuas Psammite on NN69NE.

The northerly-trending Creag Liath Fault is not exposed on NN69SE but is inferred from mapping to the north and faults out Glen Banchor succession rocks inferred to lie in the north-west corner of NN69SE.

3.2.3 Loch Garry Fault

The Loch Garry Fault is a complex of related fractures that extends across the region from the south-west corner of Sheet 64W into Cama Choire [NN 688 785], passing just south of Gaick Lodge, across Mullach Coire nan Dearcag [NN 779 862], towards Glen Feshie. It intersects the Cairngorm Granite just south of Loch Einich on Sheet 64E (Ben Macdui). The north-eastern end of the fault system may constrain the granite contact here but no significant post-emplacement faulting occurs along this north-east – south-west trending segment of the granite contact (pers. comm. M. Gillespie, 2002).

Detailed lineament analysis using aerial photographs detects a pattern strongly suggestive of a system of linked synthetic (R) and antithetic (R') Reidel shears, as well as normal faults, generated during sinistral strike-slip (see Figure 4), the 010°N trending normal faults coincide with the prominent valley of the Gaick and its continuation south into the valley of Edendon Water. The steep slopes confining Loch an t-Seilich at Gaick Lodge and Loch an Dùin are most likely reflecting underlying 010°N trending faults. Note that upper Gleann Chomhraig [NN 79

93] may be part of the same system. 010°N normal faulting can be examined at [NN 76456 88997] in the River Tromie section (downthrow to the east) while granite sheets/dykes east of Gaick Lodge at [NN 76952 85220] exploit a 010°N trending pre-existing set of faults. Brecciation on a 010°N trend at Sronphadruig Lodge [NN 71490 78310] clearly post-dates emplacement of granite sheets and the later fine-grained lamprophyre sheets and dykes. A later hornblende-diorite body at the same locality may be unaffected by faulting? This argues for an extended fault history – also for localisation of igneous rocks along this fault system. Easterly downthrow would be consistent with the general down to the east sense of displacement associated with the regional north-east – south-west trending strike-slip system (Treagus 1991).

A 30 m wide zone of cataclasis in psammites is exposed in Allt a' Chama Choire (MK363, P514843; NN7050 7962]); this fault strikes east–west to north-east – south-west and may have some reverse movement. Further up this same glen, at [NN 7002 7938], a microgranite dyke, trending 160°N, has a strongly sheared margin (effectively turning the margin of the dyke into a 'gneiss'). The fabric of this sheared margin contains epidote and chlorite, suggesting both fluid influx and deformation at fairly elevated temperatures (c. 300°C?).

3.2.4 Landslips

The steep slopes confining Loch an t-Seilich and Loch an Dùin (particularly the east facing ones) are extensively modified by post-glacial rotational land-slips. Many of the sections on the lower slopes of An Dùn show oversteepened (west-dipping) structures and extensive fracturing in the psammitic bedrock. These effects terminate uphill across localised zones of crushed green (chlorite + epidote) psammite (e.g. [NN 72145 80940]), suggesting that later rotations are, in part, re-using pre-existing faults or shatter belts in the psammite. The slopes on Sgor Dearg [NN 750 845] east of Gaick Lodge, show a spectacular series of 3 or 4 rotational slips, repeating one of the porphyritic microgranite sheets/sills in a sequence of terraces/towers on the steep hillside south of the pony path.

4 Igneous Rocks

4.1 MINOR INTRUSIONS IN NN69SE AND THE SURROUNDING AREA

Granitic pegmatites are common; associated pale granitic and aplitic granitic veins less so. Quartz-feldspar porphyritic granite is distinctive, with a pinkish red to grey matrix and locally, a mineral foliation.

Pale grey-green intermediate igneous rock (?andesite) occurs as thin sheets and dykes. This suite ranges into medium-grained varieties and some darker more mafic types (? Microdiorites). A weathered rotten example is exposed south of Allt na Ceardaich [NN 6835 9114].

A 010°N trending lamprophyre dyke crops out in the crags to the east of Am Binnein [NN 6676 9107].

4.2 MINOR INTRUSIONS ELSEWHERE ON SHEET 64W (NEWTONMORE)

Limited attention was given to the igneous bodies elsewhere in Sheet 64W. The following were noted.

- Quartz veining folded and rodded in D2.
- Pink granite or pegmatitic granite veins or thin sheets. These vary from cm or even mm-scale up to bodies several metres thick. Smallest veins are often seen perfectly concordant with S_f in psammites but then break across S_f after behaving concordantly for perhaps

several metres. These veins are never foliated - post-date both D2 and later north-east – south-west trending upright folds. Steep discordant sheets exploit pre-existing N010° trending faults, elsewhere similar granite is brecciated by such faults. Locally, sets of steep pegmatitic granite occur that cross-cut each other at high angles, both sets are discordant to the country rock and its foliation [NN 7379 8466].

- Lamprophyre sheets or dykes at m-scale, locally cross-cutting granites above, also brecciated by N010° trending faults.
- [Both granite and lamprophyres exploiting (most common along?) the Loch Garry Fault system. Fault activity both pre-dates and post-dates intrusions].
- Porphyritic microgranite sheets/sills – these form prominent features on the hillsides E and W of Gaick Lodge and again on the hilltops east of Glen Tromie. They constitute a single sill complex, apparently more prominent north of the Glen Garry Fault system than south of it. It may be worth investigating whether they are linked to the granite dykes in the fault zone itself, and to the overall north-west -side up sense of displacement on these faults.
- A body of grey, non-porphyritic granodiorite is exposed over 300 m length in the Allt Bhran Section [NN 771 897 to NN 769 899]. The margins of the body are rather 'diffuse', with a ~ 50 m wide zone of splays into psammite and rafts of psammite within granodiorite, whereby rafts can occupy 40-60% of outcrop (Figure 9). The core of the body is more homogeneous granodiorite. Individual contacts between the granodiorite and host psammite are clean and sharp, with no evidence of chilled margins or thermal alteration of the wall-rock.

5 Application of the RGGIS datasets to Sheet 64W

Examination of the datasets contained within the Regional Geophysics GIS (RGGIS) provides only a limited amount of additional information with regard to the surface distribution of lithostratigraphical units in Sheet 64W. The Gaick Psammite Formation has typically low densities (*c.* 2.65-2.70 g/cc) and thus the Gaick region is dominated by low Bouguer anomaly values. Slightly higher densities in the mica-enriched semipelites and turbiditic psammites of the Corrieyairack Subgroup in the north-west of the sheet can be distinguished as slightly higher values of residual gravity anomaly values.

The only specific feature visible on the regional aeromagnetic data (residual aeromag, reduced-to-pole) is a +ve anomaly of about 30 nT amplitude, extending *c.* 7 km SSE from Loch an t-Seilich. While there appears to be nothing remarkable in the surface lithology that relates to this anomaly, it does extend along local strike and the coincidence of a similar shaped anomaly in GBASE stream-sediment geochemical data suggests that the local psammites may be slightly more magnetic than normal. Perhaps another, but less likely?, possibility is that there is a concealed intrusion at depth, e.g. perhaps an offshoot of the Glen Tilt complex.

The Allt Bhran granodioritic intrusion does not show any clear geophysical signature, and thus seems likely to be of limited extent.

6 General Statement on the Quaternary geology

The results of the Quaternary mapping are reported in full elsewhere (2001/02 Progress Report, J. Merritt) The following summarises the main findings.

Completion of mapping across the Gaick Forest region support earlier indications that no substantial ice cap existed there during the Loch Lomond Stadial (11-10 ka BP) contradicting the models of J.B. Sissons. With the possible exception of a few, north-east-facing incipient corrie features, most glacial sediments and landforms in the region are more likely to have formed during the decay of a polythermal ice sheet during the latter stages of the Dimlington Stadial (26-13 ka BP). The ice sheet shrank into more than one dome and parts of the ice sheet sourced from the west retreated westwards from the main glacial breach through the Gaick Plateau.

A large glaciofluvial outwash fan has been identified to the north of the Gaick. It formed during deglaciation while ice in the central Gaick area separated from ice that flowed eastwards in the upper Tromie valley from the west.

References

BRITISH GEOLOGICAL SURVEY. (1999). Solid and Drift Geological Map, Sheet NN69NE (Glen Banchor). 1:10 000. (Keyworth, Nottingham: British Geological Survey.)

HIGHTON, A.J. (1999). Solid Geology of the Aviemore District. *Memoir of the British Geological Survey,* Sheet 74E (Scotland).

HINXMAN, L. W., CARRUTHERS, R. G. & MACGREGOR, M. (1923). The geology of Corrour and the Moor of Rannoch. *Memoir of the Geological Survey, Scotland,* Sheet 54 (Scotland).

KRABBENDAM, M. AND SMITH, R.A. (in prep.). Lithostratigraphy and structure along the Boundary Slide Corridor: background, problems and strategy. *British Geological Survey Internal Report, XX/02/00.*

SMITH, M., ROBERTSON, S. AND ROLLIN, K.E. (1999). Rift basin architecture and stratigraphical implications for basement-cover relationships in the Neoproterozoic Grampian Group of the Scottish Caledonides. *Journal of the Geological Society of London,* Vol. 156, 1163-1173.

THOMAS, P.R. (1979). New evidence for a Central Highland root zone. In: *The Caledonides of the British Isles - reviewed*. (eds. Harris, A.L., Holland, C.H. and Leake, B.E.*), The Geological Society of London*, Special Publications, No. 8, 205-211.

THOMAS, P.R. (1980). The stratigraphy and structure of the Moine rocks N of the Schiehallion Complex, Scotland. *Journal of the Geological Society of London*, Vol. 137, 469-482.

TREAGUS, J.E. (1991) Fault displacements in the Dalradian of the Central Highlands. *Scottish Journal of Geology,* Vol. 27, 135-145.

TREAGUS, JE. (2000). Solid Geology of the Schiehallion district*. Memoir of the British Geological Survey*, Sheet 55W (Scotland).

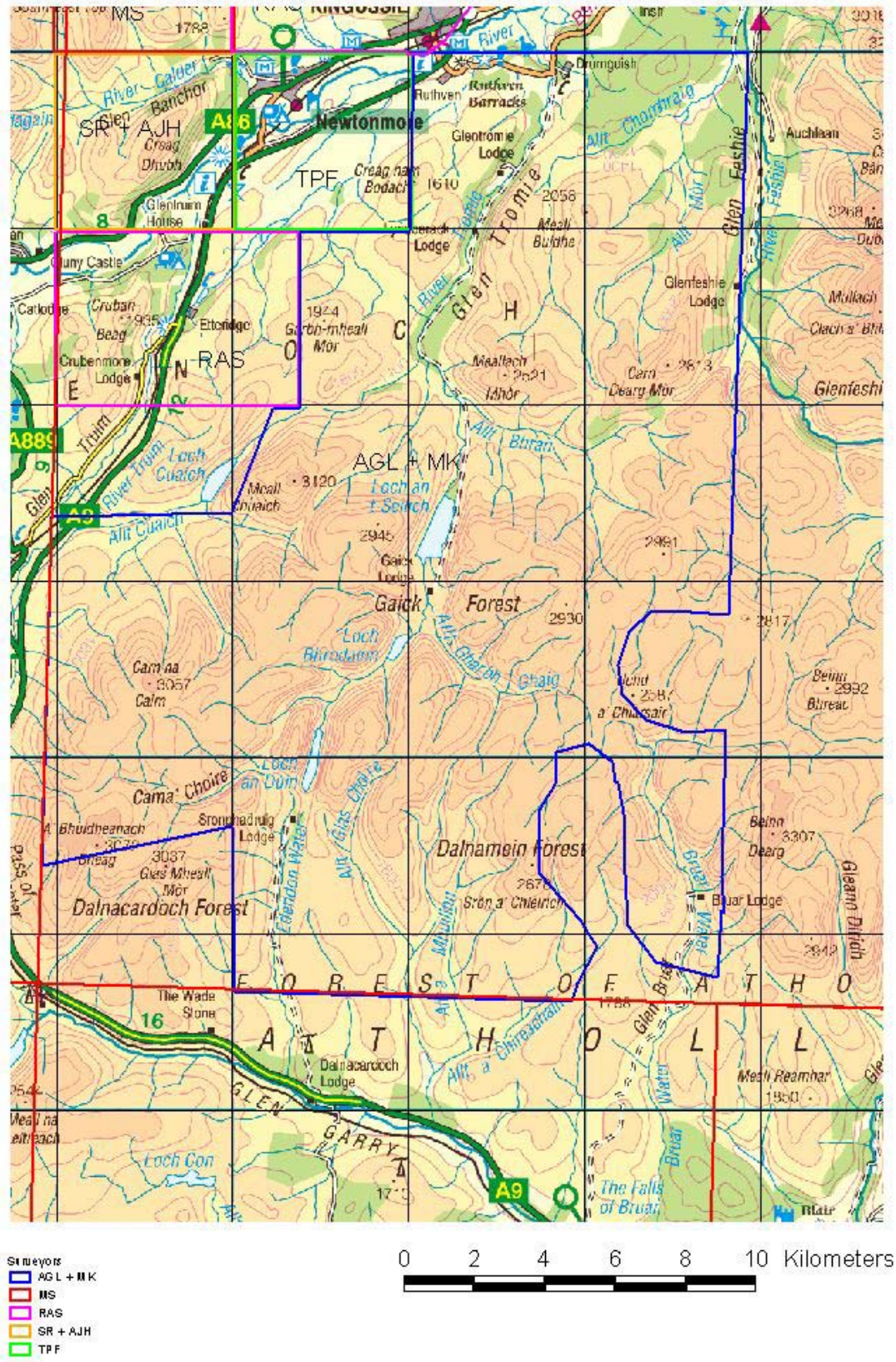


Figure 1: Topographical overview map of 1:50 000 Sheet 64W (Newtonmore).

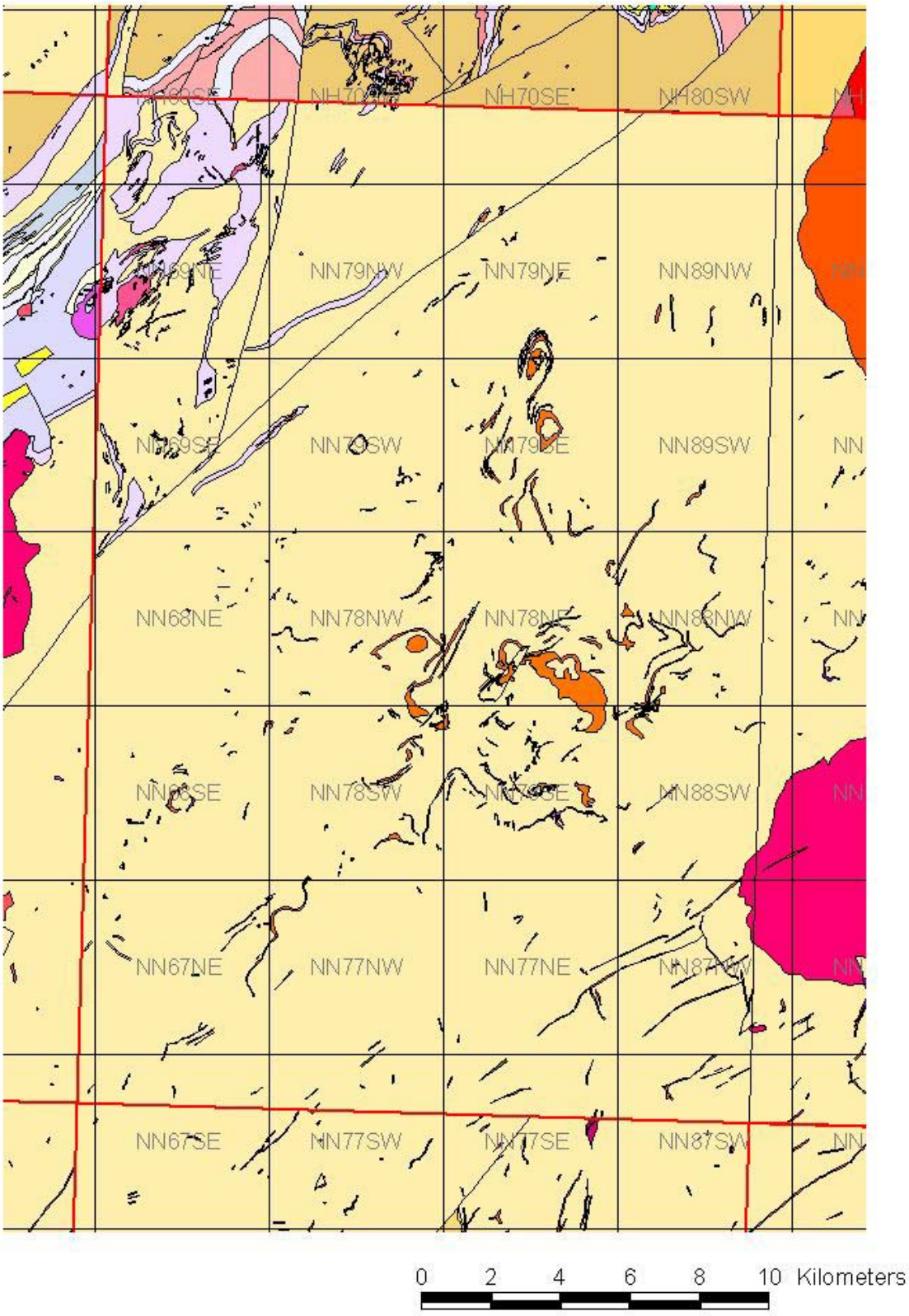
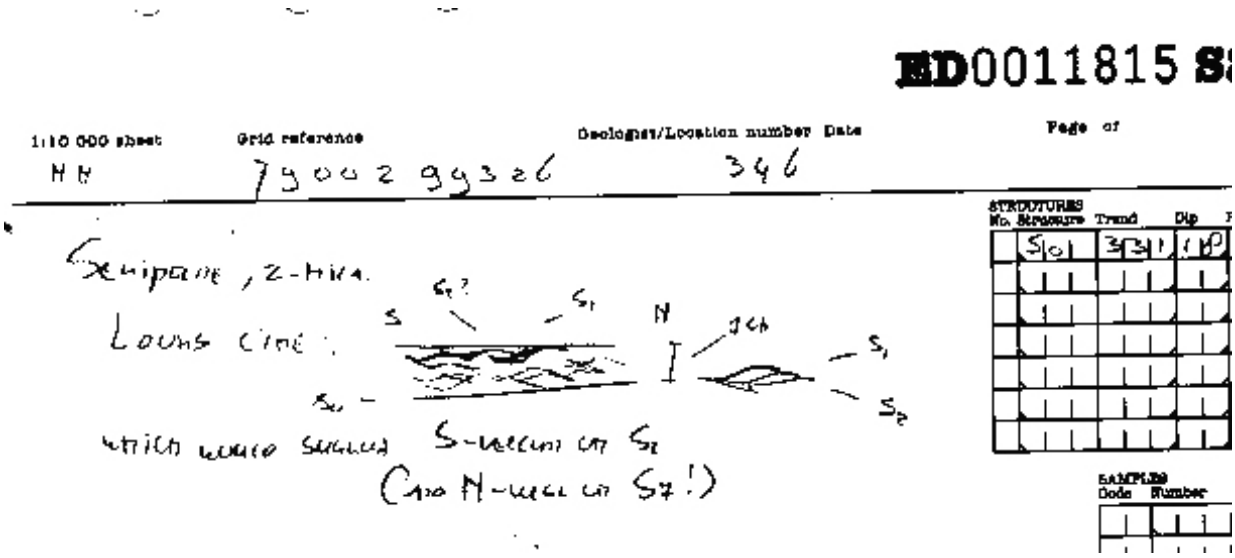


Figure 2: Geological overview of Sheet 64W (Newtonmore), taken from DigmapGB version 1.05

a)



b)

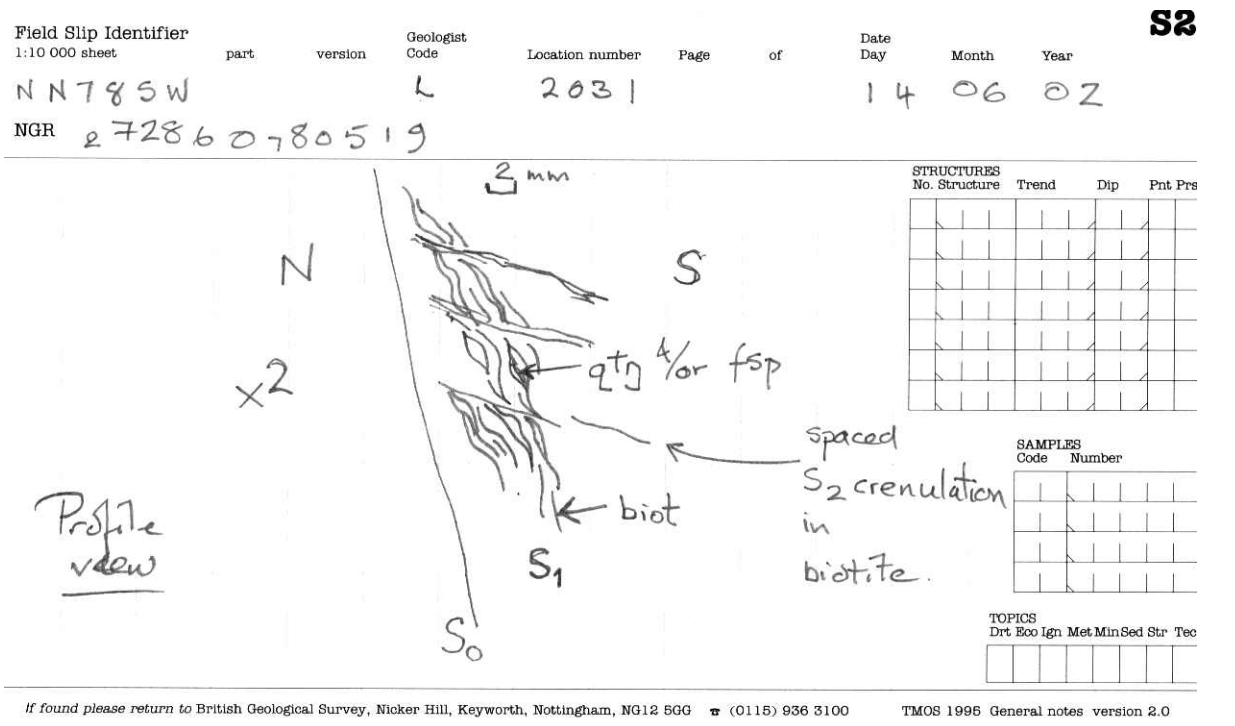


Figure 3. Field sketch of structural detail in semipelite, a) loc^{n}. no. MK346, b) loc^{n}. no. AGL2031

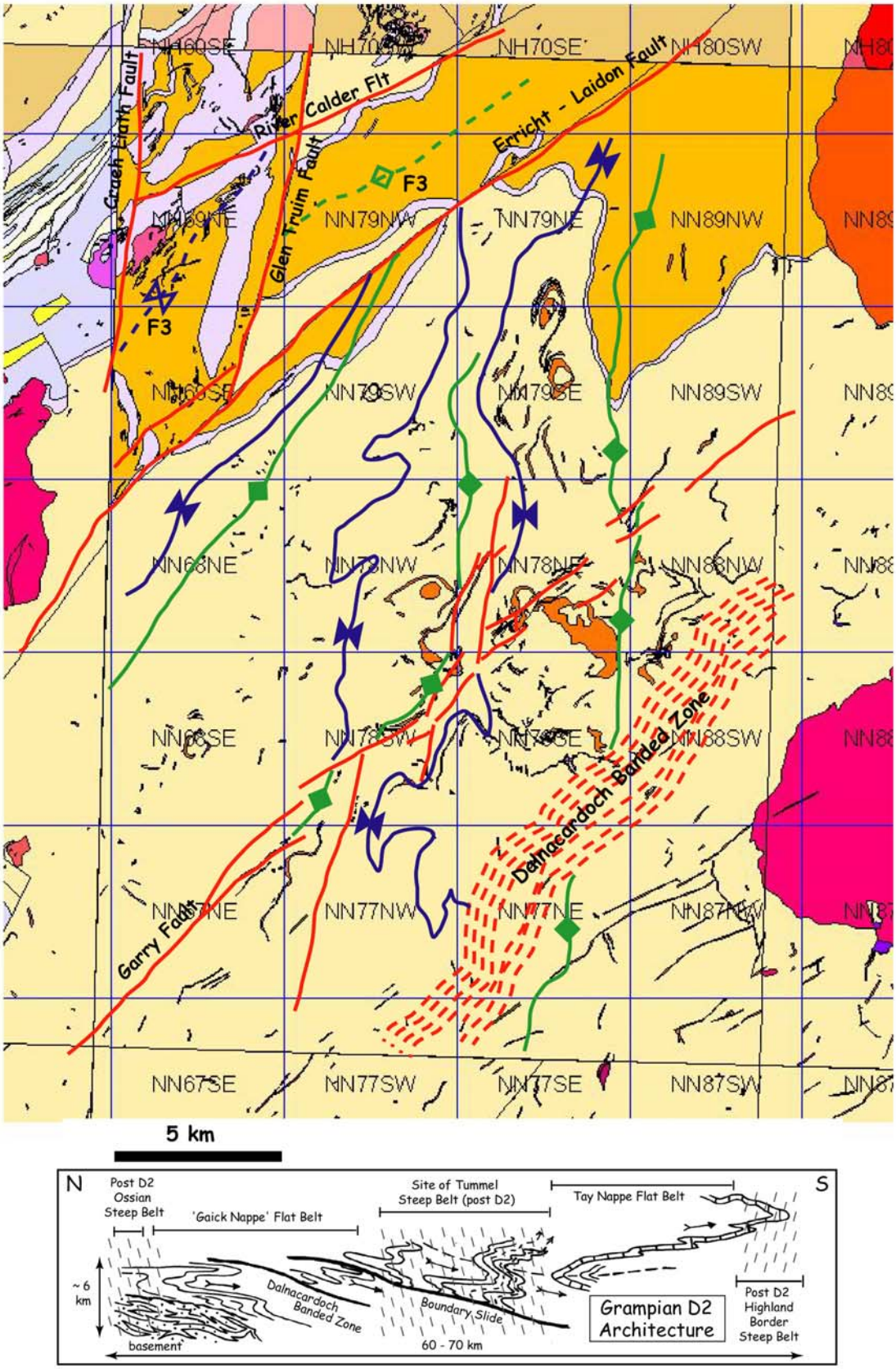


Figure 4. Outline geological map showing the main fold traces determined from the new mapping. The cross-section illustrates the D2 architecture prior to D3 deformation.

Figure 5. Tight F2 closures. Location: Am Bhuachaille NN 74115 94625], locn. no. MK 329, Photo: P514835 (M. Krabbendam).

Figure 6. Rounded closure within the overall closure of the Loch an Dùin syncline. Location: Slope east of Loch an Dùin [NN 72928 80304], locn. no. MK 225, Photo: P514813 (M. Krabbendam).

Figure 7. Cross-bedding in psammite with calc-silicate. Nearby south-verging folds suggest southward facing. Location: Allt Bhran section NN 77069 89711] , loc^{n}. no. MK 257, Photo: P514826 (M. Krabbendam).

Figure 8. Cross-bedding in psammite, within core of F2 fold (view to east); showing southward facing. Location: Allt Bhran section [NN 76559 90129] , loc^{n}. no. MK 265, Photo: P514833 (M. Krabbendam).

Figure 9. Granodiorite in a 0.8 m wide splay from the main body; contains rafts of psammite from wall-rock. Brown colour due to stream – peat staining. Location: Allt Bhran section [NN 76886 89943] , loc^{n}. no. MK 260, Photo: P514829 (M. Krabbendam).