Excursion 11 Kilsyth and Denny

Peter Craig

Purpose: To demonstrate the stratigraphy of the north-eastern outcrops of the Clyde Plateau Volcanic Formation (Strathclyde Group); to examine sedimentary strata of the Lawmuir Formation (Strathclyde Group) above, and the Ballagan and Kinnesswood formations (Inverclyde Group)immediately below the pile; to view the Midland Valley Sill-complex.

Maps: OS 1:50,000 Sheet 64 Glasgow; OS 1:25,000 Sheet 348 Campsie Fells; BGS 1:50,000 Sheet 31W Airdrie; locality maps figures 11.1, 11.2.

This excursion illustrates some lava members of the Clyde Plateau Volcanic Formation, and their petrographic variations (Forsyth *et al*., 1994). This contrasts with Fintry (Excursion 10), which deals with the complex relationships in the eruptive centres that were the source of the lavas and volcaniclastic rocks. There are ten phases of activity during the accumulation of the lavas, each represented by several different lava members cropping out in various parts of the Campsie Block. A member may be represented by a single flow in its distal outcrop, but may include more than twelve at its maximum development. (Table 11.1) presents details of the members cropping out in this area. An explanation of the groupings of the eruptive sources can be found in Excursion 10. The phases tend to be associated with an eruptive centre (or group of centres), almost 100 of which have been identified.

The other factor to be considered in unraveling the lava stratigraphy is the degree of block faulting that occurred during and after the cessation of volcanic activity. This is particularly relevant to the interpretation of the Carron valley section (Itinerary 11B).

(Table 11.1) Lava Members in the Eastern Part of the Campsie Block

Lava pile sub-division	Lava member	Dominant lava type	Eruptive source	Maximum thickness (m)	Seen at Locality
10	Craigdouffie Lavas (10C)	various	local	15+	
	Garvald Lavas (10D)	various	local	50+	B5, 7, 8, 12
9	Kilsyth Hills Lavas (9B)	fAOB/fH	WCVC	200+	
	Denny Muir Lavas (9C)	fAOB/fH	WCVC	85+	
	Gargunnock Hills Lavas (9D)	fAOB/fH	WCVC	90+	A4
6	Langhill Lavas (6B)	M	?	35	B1
	5 Upper North Campsie Lavas (5A)	BH/H	NC/GGLVS	215	
	Upper South Campsie Lavas (5B)	H	SCLVS	60	
4	Overton Lavas (4D)	fH/M	?	35	
	3 Lower North Campsie Lavas (3A)	H	NCLVS	70	

	Lower South Campsie Lavas (3B)	AOB/BH	SCLVS	135	
	Faughlin Lavas (3C)	H/M	?local	35	
	Tappetknowe Lavas (3D)	H/M	?local	40	A4
2	Laird's Loup Lavas (2B)	fBH/fH	?SCLVS	65	
	Carron Bridge Lavas (2C)	fBH/fH	?	50+	B2, 3
1	Drumnessie Lavas (1A)	AOB	SCLVS	60	A3

Abbreviations:

f – feldspar-phyric
AOB – alkali olivine basalt
BH – basaltic hawaiite
H – hawaiite
M – mugearite

NCLVS – North Campsie Linear Vent System
GGLVS – Gonachan Glen Linear Vent System
SCLVS – South Campsie Linear Vent System
WCVC – Waterhead Central Volcanic Complex

Itinerary 11A: Berryhill, north of Kilsyth

Logistics: This itinerary starts in strata at the base of the volcanic pile, exposed to the east of the unclassified Tak-Ma-Doon Road between Kilsyth and Carron Bridge. The road is unsuitable for coaches except for the first 1.5 km from the Kilsyth end. Coach parties should walk the last 500 m or so north to the first locality at the road bend just north of Berryhill, now farmed from Glenhead, High Banton. Cars may be parked in the lay-by area [NS 7286 8060] about 2.5 km north of Kilsyth, and 400 m north of the first locality. The total walking distance for this excursion is little more than 1 km, and two hours should prove adequate. Wellington boots are advisable. The area adjacent to the Berryhill waterfall is subject to active rockfall, with resultant changes in the details that can be observed in the exposures.

Locality 11.1 [NS 7300 8025] North of Berryhill: subvolcanic sill of feldspar-phyric basalt with xenoliths.

Immediately east of the bend in the road are exposures of what was formerly interpreted as the earliest lava flow interdigitated with prevolcanic sandstones. The rock is a fresh, feldspar-phyric basalt with pronounced ophitic texture. The freshness, texture and presence of many xenoliths are now known to be typical of rocks intruded into the sedimentary strata underlying the lava pile. These outcrops are now regarded as the eastern extremity of a sill-like body that can be traced westwards beneath the volcanic pile for a distance of 900 m. The exposures reveal the localised presence of many xenoliths of indurated sandstone and mudstone, especially in the higher exposures.

Locality 11.2 [NS 7312 8035] Banton Burn: dolostones (cementstones) and mudstones of the Ballagan Formation.

In the Banton Burn section less than 200 m to the east, high-ferroan dolostone (cementstone), mudstone and some fine-grained sandstones of the Ballagan Formation are seen dipping northwards towards the Berryhill waterfall (Plate S.4). Up to 400 m of these beds underlie the volcanic pile to the north and west of the Campsie Block, but in the BGS Tak-Ma-Doon Borehole [NS 729 805], sunk only a few hundred metres to the NW of this locality, only 20 m of the Ballagan Formation separated the base of the lava pile from strata of the Kinnesswood Formation. In the Bachille Burn section 3 km to the west, the Ballagan Formation is absent. On a regional basis therefore, it is clear that there is a marked unconformity between the base of the Clyde Plateau Volcanic Formation and the underlying sedimentary strata. The Kinnesswood Formation is not well exposed at this locality. The sequence consists of fine- to medium-grained, cross-bedded sandstones, generally pale in colour. Calcrete concretions are commonly present within the finer grained beds and in places form nodular deposits up to a metre in thickness. Continue NW along the burn to reach a waterfall.

Locality 11.3 [NS 7305 8045] Berryhill waterfall: base of the volcanic pile and multiple dyke intrusion.

At first sight, the waterfall appears to represent a typical trap feature with more-resistant lava overhanging eroded and decomposed subflow scoria and pyroclastic rocks (Plate 11.1). Closer examination reveals that the face of the waterfall is in fact the southern margin of a 10 m zone of multiple dyke intrusions, showing sidestepping and minor faulting. In the east bank section, Ballagan Formation dolostones and mudstones at stream level are overlain by a sequence of stratified tuffs. Some of these are clearly of 'accidental' character, being composed of sandstone grains and fragments. Such tuffs are frequently associated with the onset of new phases of volcanic activity as new conduits were reamed through the country rock to deliver rising magma to the surface. The pyroclastic rocks are in turn overlain by the basal lava flow of the Clyde Plateau Volcanic Formation, a 4 m-thick massive microporphyritic basalt assigned to the Drumnessie Lavas (1A in (Table 11.1)). Leave the burn westwards to the road and return to the lay-by.

Locality 11.4 [NS 7288 8070] North of Tak-Ma-Doon Road: mugearitic and hawaiitic lavas.

To the north of the lay-by, where the road swings sharply eastward, the steep slope rising above the road has several small exposures of platy-jointed mugearitic lava belonging to the Tappetknowe Lavas (3D in (Table 11.1)). Such lavas are believed to have resulted from differentiation of basaltic magma in the upper crust when the lighter felsic minerals separated from the denser ferromagnesian minerals during periods of stagnation between eruptions. The lighter materials produced pale, platy-jointed lavas whose originally greater viscosity is apparent in their less regular form and consequent stratigraphical unreliability. Immediately NW of the sharp bend, the mugearitic outcrops cease abruptly. Here the Katie Fristy Well Fault throws down feldspar-phyric hawaiite ('Markle basalt' on earlier maps) typical of the Kilsyth Hills and Denny Muir Lavas (9C and 9B in (Table 11.1)) by about 30 m. These lavas crop out on either side of the Tak-Ma-Doon road for almost 2 km northwards as far as the ford. Return to vehicles.

Itinerary 11B : River Carron west of Denny

Logistics: If the Tak-Ma-Doon road has been followed from Berryhill to Carron Bridge, the landscape to the east of the road lacks continuous trap featuring at lower levels because the lava flows are of proximal facies. They tend to be irregular, slaggy bodies with a relatively high proportion of interflow scoriaceous and tuffaceous rocks. Park in the lay-by on the Carron Bridge to Denny road (B818) near Easter Langhill [NS 7726 8396]. Walk westwards along the road for 350 m and turn northwards to Langhill Farm. Check at the farmhouse for the best route down to the River Carron to avoid disturbance of livestock. The circular route is 5 km long, and will take at least three hours. Most of the walking is on roads, paths, or easy terrain.

Locality 11.5 [NS 7730 8460] South to north bank of River Carron: dipping trap feature.

From about 400 m NNE of Langhill, a particularly thick flow of mugearite can be seen in the north bank of the river. It forms a 15 m-high trap feature dipping generally east. Apart from the heavily and irregularly jointed top and bottom metre or so, the lava is massive and displays coarse columnar jointing, more-typical of the thicker flows of less-evolved basalt and hawaiite of this area. Its unusual thickness and coarse jointing indicate that it is probably near source. It may have been emplaced in a lava lake. More-typical flow textures of mugearites in the Campsie Block reflect increasing viscosity with cooling and generation of the characteristic platy jointing by flowing. This is the basal flow of the Langhill Lavas (6B in (Table 11.1)) and overlies the Upper Campsie Lavas (5A and B in (Table 11.1)) that crop out upstream. Within the Campsie Block, relatively steep dips such as that exhibited by this feature are usually associated with faulting.
More-direct evidence of fault disturbance can be seen at the next locality. Should closer examination of the mugearite be desired, a footbridge [NS 7628 8462] some 450 m or so upstream gives access to the north bank. Otherwise, and provided the river is not in spate, proceed downstream along the south bank and cross at the aqueduct [NS 7703 8462] about 200 m downstream. Other flows belonging to the Langhill Lavas are exposed here, and have the chilled and shattered appearance more typical of mugearites.

Locality 11.6 [NS 7745 8445] River Carron: non-porphyritic lava in faulted contact with feldspar-phyric lava.

This is one of the few localities in the Campsie Fells where the presence of a fault is clearly demonstrable and can be accurately located. A sizeable crag of feldspar-phyric lava rises from the river's edge on the south bank, while most of the river bed and north bank exposures are of mugearitic lavas of the Langhill Member. The line of the fault can be traced between the two lava types. The south bank lavas belong to the older Carron Bridge Lavas (2C in (Table 11.1)). An estimated 70 m of strata are thrown down to the north by this fault. It is an extension of the Shielwalls and Langhill faults, which come together just to the west of this locality.

Locality 11.7 [NS 7770 8425] River Carron: feldspar-phyric lava.

Feldspar-phyric lavas of the Carron Bridge Lava Member are exposed moreor-less continuously for the next 500 m downstream. Follow the north bank path to the next locality.

Locality 11.8 [NS 7795 8403] River Carron: volcaniclastic breccia, probably in or near a vent.

These distinctive outcrops are readily examined from the north bank. They are interpreted as being separated from the lava outcrops immediately upstream by the Carron Glen Fault. With an estimated throw of 100 m, this fault has brought down to the east the topmost lavas in this part of the Campsie Block, the Garvald Lavas (10D in (Table 11.1)) that, unlike most other members have considerable petrographic diversity. Microporphyritic and macroporphyritic basalts and hawaiites have been identified, as well as at least one mugearite. The outcrops here however, are of coarse unsorted breccia, largely composed of feldspar-phyric lava fragments (Plate 11.2). Crude stratification is apparent in places. There are no obvious magmatic intrusions or intrusive tuffisite veins such as might be expected to cut through vent breccia, but some evidence for such features has been detected in outcrops to the north. The breccia may well have been emplaced as a debris flow, but whether it occupies a vent or forms part of a largely obscured tephra cone is impossible to determine. It is reasonable to conclude nonetheless, that an eruptive vent was active near to this locality and, more importantly, at this stratigraphical level. Since the adjacent lavas are near the top of the local volcanic sequence, it follows that this presumed vent must have been one of the last to be active during the accumulation of the lava pile.

Locality 11.9 [NS 7815 8390] River Carron: pillow lava.

To reach the next locality, follow the path that ascends the north side of Carron Glen, away from the river. Where the path descends again, and some 2 m before it levels out, turn sharp right and scramble down to the exposure at the river's edge. Small-scale pillowing of the lava is clearly displayed, while rather less-obvious pillowing is present in many of the microporphyritic lava exposures in the river bank for almost 100 m upstream. Pillowing is also apparent in the south bank exposure immediately opposite.

This distinctive structure indicates eruption of lava beneath or into water. The localised and rather poorly developed pillowing is probably indicative of the presence of shallow and discontinuous bodies of water at the time of eruption. The only other localities within the Campsie Block where pillowing has been observed lie at a similar stratigraphical level (10D in (Table 11.1)), about 1 km to the SSW.

Locality 11.10 [NS 7842 8378] Carron Glen: Midland Valley Sill-complex.

Return to the north bank path and continue to follow it downstream. Spheroidal weathering should be visible in the crags high above the path before it reaches its highest point. Such weathering is characteristic of the major quartz-dolerite sill that forms such a prominent topographic feature between the Wallace Monument to the NE of Stirling, and Myot Hill [NS 7810 8250] some 1.4 km to the south of this locality. Here the quartzdolerite is intruded into the sedimentary strata immediately above the top of the lava pile. The sill will be more readily examined at Locality 11.17, Myot Hill where the excursion ends.

Locality 11.11 [NS 7860 8350] Carron Glen: top of lava sequence.

As the path descends again, note the view back upstream where the river has cut a gorge into the lava flow sequence. At Locality 11.11 the path follows the top of an 8 m-thick lava flow that forms a steep cliff plunging down to the river on the

right. On the left, a rather unstable and degraded exposure reveals the topmost strata of the lava pile at this locality. The lower part of the exposure is in soft, purplish weathered, scoriaceous rock, which probably represents the slaggy top of the thick flow beneath. The top 40cm or so of the section, however, are of flaggy-bedded, pale, medium-grained sandstone. This is the first non-volcanic sedimentary rock in the succession since those below the first lava flow, and signals the end of the eruptive episode.

Locality 11.12 [NS 7860 8343] River Carron: topmost lava flow.

Continue descending the path and take the right fork. Proceed down to the river for a view of the heavily jointed, locally platy-jointed, lava flow that here forms the topmost of the Garvald Lavas (10D in (Table 11.1)), the top of the Clyde Plateau Volcanic Formation. The base of the flow can be seen dipping downstream and into the north bank.

Locality 11.13 [NS 7870 8323] River Carron: sedimentary strata above the lavas.

Whilst following the path downstream to the footbridge across the River Carron, the Garvald Burn can be observed flowing into the Carron from the south. The lower part of this stream section is unfortunately polluted and choked with rubbish and thus cannot be recommended. Just before crossing the Carron footbridge the outcrops on the south bank can be viewed across the river. They comprise sedimentary strata (Lawmuir Formation) immediately above a volcaniclastic sedimentary assemblage (Kirkwood Formation) and are followed directly by the quartz-dolerite sill, the contact with which may be faulted. A combination of faulting and the general eastward dip of the strata in this area have brought this contact down to river level. **The exposures are only accessible to the agile**. They reveal a thin sequence of generally dark-coloured, volcanically derived fine conglomerates passing upwards into dark-grey and then pale-buff, fine- to medium-grained, cross-bedded sandstones. Slickensides and alteration are evident in the baked dark-grey sandstone immediately beneath the base of the dolerite intrusion.

To reach Locality 11.14, cross the Carron footbridge and climb the north bank to the public road. Turn right along the road and follow it (with due regard to the hazardous bends) for about 600 m to the west, as far as the bridge across the Garvald Burn.

Locality 11.14 [NS 7811 8294] Garvald Burn: Kirkwood Formation siltstones.

The exposures upstream from this bridge [NS 7819 8308] are of a rather slaggy and decomposed lava flow, which here defines the top of the lava pile. At Locality 11.14, a 2.5 m section of grey and green siltstones overlies the lava (Plate 11.3). These appear massive and structureless to the north, but are clearly laminated towards the south end of the exposure [NS 7809 8292], where they dip at 15° east. What appear to be completely decomposed pebbles can be seen within these beds.

Locality 11.15 [NS 7807 8286] Kirkwood Formation conglomerates and siltstones.

In this 4 m section, most of the rock is a coarse conglomeratic unit with rounded boulders up to 30 cm in diameter of a variety of lava types. The calcareous matrix is generally sparse but some thin lenses of sandstone and pebbly fine conglomerate are present locally. The upper part of the section appears to consist of largely non-volcaniclastic flaggy sandstones and siltstones, locally with conspicuous cross-bedding.

Locality 11.16 [NS 7789 8278] Garvald Burn: Clyde Plateau Volcanic Formation feldspar-phyric lava, tuff and scoria.

This interesting 5 m section in the NW bank of the burn differs from anything seen elsewhere within the Campsie Block. Subaerially weathered feldspar-phyric lava and pyroclastic rocks are quite common, but the nature of this section suggests accumulation in water. At the SW end of the exposure, the lava gives the appearance of pillowing (Plate 11.4). Highly altered lumps of lava within the fragmental material that comprises most of the rest of the exposure might well represent detached pillows. Though generally soft and decomposed, the fragmental material seems likely to have originated as crystal-rich tuffs deposited in water.

Locality 11.17 [NS 7790 8255] South of Garvald Burn: base of quartz-dolerite sill.

This final locality, some 100 m or so south of the previous, provides a further opportunity to examine the basal contact of this southernmost extension of the sill. Chilled dolerite crops out immediately above about 1 m of indurated silty mudstones (Lower Limestone Formation) seen dipping to the SE at about 20°. Depending on weather conditions and stamina, it may be well worth visiting the summit of Myot Hill [NS 7810 8250] just to the east of this locality for the fine view of the eastern Midland Valley. The panorama extends from the Ochil Hills to the NE, across the lower Forth valley to the Pentland Hills and Bathgate Hills and southwards over the Clyde valley and its conurbations to the distant hills of Lanark and the distinctive peak of Tinto. To return to the Easter Langhill lay-by, go back to the road bridge across the Garvald Burn, turn left and take the right hand road at the nearby junction for 1.3 km.

References

Table 11.1

Lava Members in the Eastern Part of the Campsie Block

Lava pile sub-division	Lava member	Dominant lava type	Eruptive source	Maximum thickness (m)	Seen at Locality
10	Craigdouffie Lavas (10C)	various	local	15+	
	Garvald Lavas (10D)	various	local	50+	B5, 7, 8, 12
9	Kilsyth Hills Lavas (9B)	fAOB/fH	WCVC	200+	
	Denny Muir Lavas (9C)	fAOB/fH	WCVC	85+	
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6	Langhill Lavas (6B)	M	?	35	B1
5	Upper North Campsie Lavas (5A)	BH/H	NC/GGLVS	215	
	Upper South Campsie Lavas (5B)	H	SCLVS	60	
4	Overton Lavas (4D)	fH/M	?	35	
3	Lower North Campsie Lavas (3A)	H	NCLVS	70	
	Lower South Campsie Lavas (3B)	AOB/BH	SCLVS	135	
	Faughlin Lavas (3C)	H/M	?local	35	
	Tappetknowe Lavas (3D)	H/M	?local	40	A4
2	Laird's Loup Lavas (2B)	fBH/fH	?SCLVS	65	
	Carron Bridge Lavas (2C)	fBH/fH	?	50+	B2, 3
1	Drumnessie Lavas (1A)	AOB	SCLVS	60	A3

Abbreviations:

f – feldspar-phyric
AOB – alkali olivine basalt
BH – basaltic hawaiite
H – hawaiite
M – mugearite

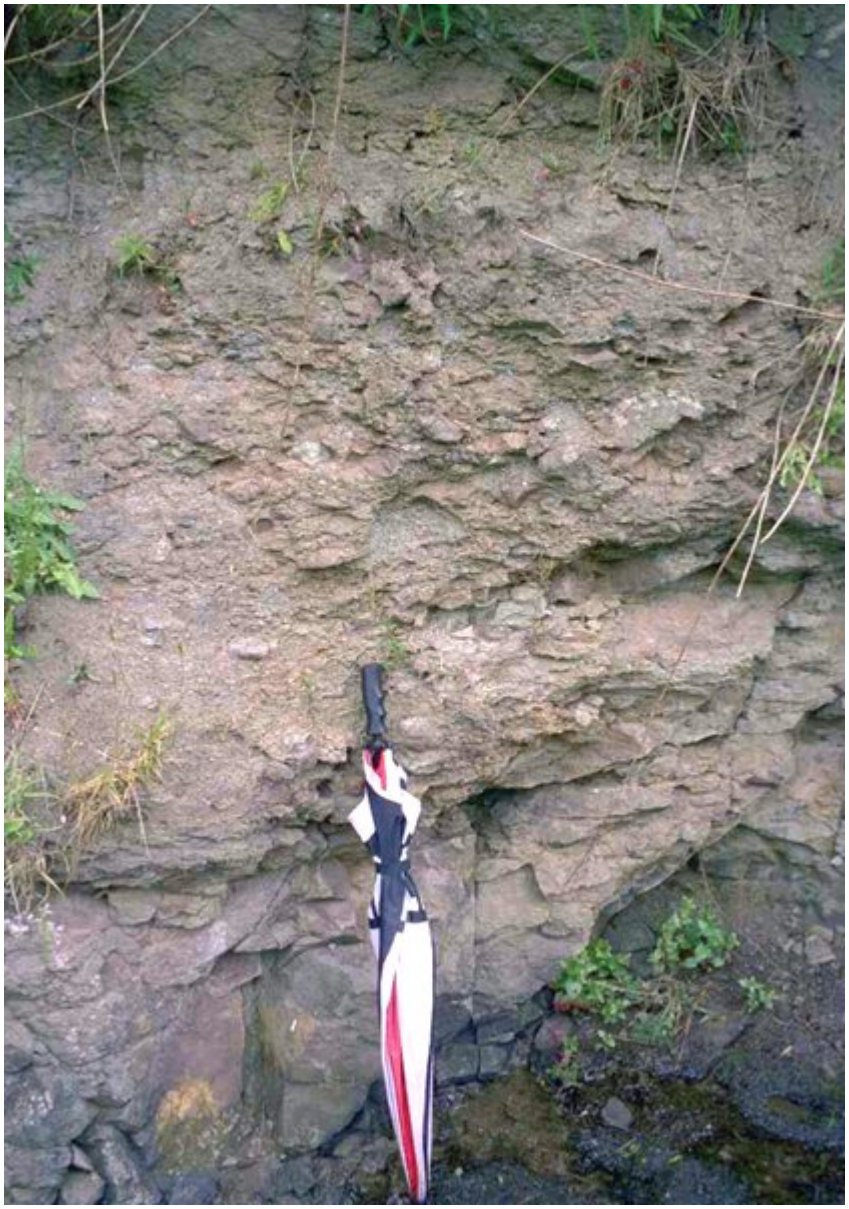
NCLVS – North Campsie Linear Vent System
GGLVS – Gonachan Glen Linear Vent System
SCLVS – South Campsie Linear Vent System
WCVC – Waterhead Central Volcanic Complex

(Table 11.1) Lava Members in the Eastern Part of the Campsie Block.

(Plate S.4) Lower Carboniferous Ballagan Formation mudstones with beds of dolostone (cementstone) in Banton Burn. See Excursion 11.

(Plate 11.1) Locality 11.3. Basal basalt lava of the Clyde Plateau Volcanic Formation (Drumnessie Lavas), overlying red decomposed pyroclastic rocks (seen to the right of the figure) and with basaltic dyke forming face of waterfall in Banton Burn.

(Plate 11.2) Locality 11.8. Volcaniclastic breccia, bank of River Carron.



(Plate 11.3) Locality 11.14. Kirkwood Formation conglomerate and siltstone, Garvald Burn.

(Plate 11.4) Locality 11.16. Weathered pillows (?). Garvald Burn.