
Tables

(Table 1.1) Carboniferous-Permian Igneous Rocks Block: GCR networks and site selection criteria.

Site name	GCR selection criteria
Chapter 2	Dinantian volcanic rocks of the Midland Valley of Scotland and adjacent areas Network
North Berwick Coast	Representative of the lower, basic members of the Garleton Hills Volcanic Formation. Exceptional examples of tuff-rings and small-scale volcanic vents. Internationally important for crustal and mantle xenoliths.
Garleton Hills	Representative of the trachytic upper member of the Garleton Hills Volcanic Formation and of Dinantian trachytic volcanism in general.
Traprain Law	Representative of the silica-undersaturated, highly evolved intrusions of East Lothian. Exceptional example of a laccolith.
Arthur's Seat Volcano	Representative of the Arthur's Seat Volcanic Formation. Exceptional examples of classic volcanic features that dominate the city landscape, influencing development and culture. Internationally important for the historical development of geology and understanding of igneous processes.
Burntisland to Kinghorn Coast	Representative of the Kinghorn Volcanic Formation. Examples of fragmented lava (hyaloclastite) with associated pillow lavas, formed in a marine lava delta.
Touch, Fintry and Gargunnock Hills	Representative of the north-eastern part of the Clyde Plateau Volcanic Formation. Exceptional example of a volcanic escarpment with 'trap' features.
Campsie Fells	Representative of the northern part of the Clyde Plateau Volcanic Formation and of the North Campsie Linear Vent System. Exceptional examples of volcanic vents, remnants of ash cones and plugs.
Dumbarton Rock	Exceptional example of a visually striking volcanic plug associated with the Clyde Plateau Volcanic Formation.
Dunrod Hill	Exceptional examples of composite hawaiitic lava flows with potential international importance. Representative of the dominant member in the western part of the Clyde Plateau Volcanic Formation.
Machrihanish Coast and South Kintyre	Representative of Dinantian volcanism north-west of the Highland Boundary Fault. Exceptional example of a trachyte lava dome.
Heads of Ayr	Exceptional example of a Dinantian volcanic neck, comprising the roots of a tuff-ring, with superb three-dimensional coastal exposures. Contains crustal and upper mantle xenoliths.
Chapter 3	Dinantian rocks of the Northumberland, Solway and Tweed basins Network
Gill Beck	Representative of the Tournaisian Cockermouth Lavas.

Bothel Craggs Quarry

Representative of a tholeiitic andesite lava, rare in the British Carboniferous lava successions and providing evidence for fractionation of the tholeiitic magmas.

Little Mell Fell Quarry

Representative of dykes and pyroclastic rocks of a neck, both associated with the Cockermouth Lavas but well to the east of the main outcrop.

Langholm–Newcastleton Hills

Representative of the Tournaisian Birrenswark Volcanic Formation.

Lintmill Railway Cutting

Representative of the Tournaisian Kelso Lavas.

Hareheugh Craigs

Representative of the plugs associated with the Kelso Lavas. A rare composite example.

Cottonshope Head Quarry

Representative of the Tournaisian Cottonshope basalts.

Kershope Bridge

Representative of the Visean Kershopefoot basalts.

River Esk, Glencartholm

Representative of the Visean Glencartholm Volcanic Beds.

Chapter 4

Silesian and Early Permian volcanic rocks of Scotland Network

Ardrossan to Saltcoats Coast (Chapter 5)

Representative of the Namurian Troon Volcanic Member and the Ayrshire Bauxitic Clay Member.

East Fife Coast

Representative of Late Carboniferous to Early Permian necks. Internationally renowned for cross-sections through the roots of phreatomagmatic tuff-rings at various structural levels. Exceptional examples of crustal and upper-mantle xenoliths.

Howford Bridge

Representative of the Early Permian Mauchline Volcanic Formation.

Carron Water

Representative of the Early Permian Carron Basalt Formation. Exceptional examples of volcanic rocks interdigitating with contemporaneous fluvial and aeolian sedimentary rocks.

Chapter 5

Alkaline basic sills and dykes of Scotland Network,

Arthur's Seat Volcano (Chapter 1)

Representative of alkali dolerite sills of various ages in the eastern Midland Valley. Exceptional examples of both upper and lower contacts that have great historical significance and hence international importance. Spectacular part of the city landscape.

South Queensferry to Hound Point

Representative of alkali dolerite sills in the eastern Midland Valley. Internal mineralogical and textural variations are well displayed. Exceptional examples of hydrothermal alteration to 'white trap'.

Ardrossan to Saltcoats Coast

Representative of the composite alkali dolerite sills of the western Midland Valley. Exceptional examples of internal and external contacts and of metamorphic effects on the sedimentary country rocks.

Lugar

Internationally important example of a composite, alkaline basic sill, both historically and in recent times.

Benbeoch

Representative of the early Permian alkaline basic sills of the western Midland Valley, exhibiting a wide variety of rock-types from peridotite to spectacular late fractionates termed 'lugarite'.

Representative of olivine-rich alkaline basic sills of the western Midland Valley. Exceptional examples of fresh, olivine-rich, nepheline-dolerite.

Craighead Quarry	Representative of the rare Late Carboniferous to Early Permian intrusions within the Southern Uplands. An exceptionally fresh and visually striking porphyritic nepheline-gabbro, formerly termed an 'essexite'.
Dubh Loch	Visually striking representative of the Late Carboniferous to Permian lamprophyric dykes of the western Highlands. Contains exceptional examples of mantle xenoliths and xenocrysts.
Chapter 6	Toleitic sills and dykes of Scotland and northern England Network
South Queensferry to Hound Point (Chapter 5)	Representative of the Midland Valley Sill-complex. Exceptional example of a basal contact, exhibiting multiple intrusive sheets and apophyses, chilled margins, thermally altered sedimentary rocks.
North Queensferry Road Cuttings	Representative of the Midland Valley Sill-complex exhibiting a complete section. Exceptional examples of many of the features that characterize large sills, including baked sediments on top of the sill that prove that it is an intrusion.
Wallstale	Representative of the Midland Valley Sill-complex. Exceptional example of a vertical transgression along a fault plane.
Lomond Hills	Representative of the Midland Valley Sill-complex forming a prominent scarp feature. Exceptional example of large-scale transgressive contacts and thermal effects above the sill. Equivocal relationships between the sill and alkaline basic plugs have generated much debate.
Gloom Hill, Dollar	Representative of the Ochil Fault-intrusion.
Mollinsburn Cuttings	Representative of quartz-dolerite dykes of the tholeiitic dyke-swarm of central Scotland. Exceptional examples of horizontal columnar joints.
Corsiiehill Quarry	Representative of basalt dykes of the tholeiitic dyke-swarm of central
Whin Sill Exposures in Upper Teesdale	Scotland. Exceptionally well-exposed vertical contacts and horizontal columnar joints.
Steel Rigg to Sewingshields Crags	Representative of the thickest part of the Great Whin Sill at its lowest stratigraphical level. Nationally important landscape features exhibit exceptional examples of many of the features that characterize large sills, including baked sedimentary rocks on top of the sill, which prove that it is an intrusion, transgressive upper and lower contacts, columnar jointing and a pegmatitic central facies.
	Representative of the Great Whin Sill forming a major landscape feature of international historical importance.
	Exceptional features include offsets in the scarp attributed to transgression between stratigraphical levels and baked sedimentary rocks above the sill, which prove that it is an intrusion.

Longhoughton Quarry

Representative of the Great Whin Sill. Exceptional features include baked sedimentary rocks above the sill, and rafts of sedimentary rock in the upper part, which prove that it is an intrusion. The relationship of the sill to movement on the Longhoughton Fault is also clearly displayed.

Cullernose Point to Castle Point

Representative of the Great Whin Sill. Exceptional features include well-developed columnar jointing, rafts of baked sedimentary rock and late-stage veins.

Budle Point to Harkess Rocks

Representative of the Great Whin Sill. Exceptional for the large number of rafts of sedimentary rocks with varying orientations. Internationally important for the presence of miniature ropy flow texture on the insides of large vesicles.

Greenfoot Quarry

Representative of the Little Whin Sill.

Holy Island

Representative of the Holy Island dyke subswarm, which is related to the Whin Sill-complex. Exceptional example of an intrusion showing 'step-and-stair' transgression and numerous contact features. Internationally important for the presence of miniature ropy flow texture on the insides of large vesicles.

Wydon

Representative of the St Oswald's Chapel dyke subswarm, which is related to the Whin Sill-complex. A rare natural inland exposure of a simple dyke.

Chapter 7

Carboniferous and Permian igneous rocks of central England and the Welsh Borderland Network

Litton Mill Railway Cutting

Representative of the upper part of the Visean Upper Miller's Dale Lava of Derbyshire. Exceptional example of the brecciation of a lava flow that terminated in an aqueous environment.

Water Swallows Quarry

The Water Swallows Sill, representative of the alkali dolerite sills of Derbyshire, is intruded into the Visean Lower Miller's Dale Lava. Exceptional examples of columnar jointing and of mineral layering in the sill.

Tideswell Dale

The Tideswell Dale Sill, representative of the alkali dolerite sills of Derbyshire, is intruded into the Visean Lower Miller's Dale Lava. The sill shows chilled margins and thermal alteration of country rocks.

Calton Hill

The Calton Hill Volcanic Complex comprises the remains of a phreatic tuff-ring associated with the Upper Miller's Dale Lava, intruded by basanite sills. Internationally important as the only locality in England at which mantle xenoliths can be found.

Clee Hill Quarries

The Clee Hills Sill is representative of the West Midlands suite of Late Carboniferous alkali dolerite sills.

Barrow Hill

The Barrow Hill Complex is an exceptional example of a Westphalian volcanic vent with associated volcanic deposits. Internationally important for the presence of the oldest anatomically preserved conifers found to date.

Middle Hope	Representative of Tournaisian Middle Hope Volcanic Beds of south-west England. Exceptional examples of lapilli-tuffs and pillow lava. Nationally important for the association of igneous, sedimentological and palaeontological features that allow reconstruction of the growth and subsequent subsidence of a volcanic cone on a marine carbonate shelf.
Spring Cove	Representative of Visean volcanic rocks of south-west England. Exceptional example of a pillow lava erupted under water in a marine carbonate environment.
Golden Hill Quarry	Exceptional example of a monchiquite intrusion associated with a Visean volcanic pipe. Internationally important as the only locality in Wales at which mantle xenoliths are found.

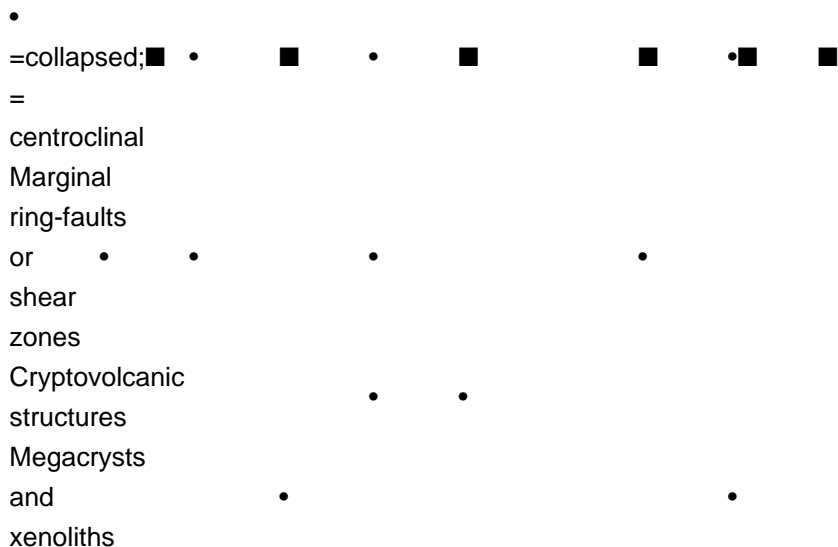
Table 2.1 **Succession of the Clyde Plateau Volcanic Formation in the northern part of the Touch, Fintry and Gargunnock hills.** (After Francis *et al.*, 1970, table 7.)

Fintry Hills	Touch and Gargunnock hills
Kirkwood Formation	
Conglomerates, sandstones and mudstones derived from weathering of Clyde Plateau Volcanic Formation	
————— Regional diachronous erosional unconformity —————	
	Touch House Member (thickness not known) Feldspar-macrophyric olivine basalts
	Black Mount Member (>24 metres) Microporphyritic basalts and subordinate trachybasalts
	Gargunnock Hills Member (91—>152 metres) Feldspar-macrophyric olivine basalts and composite basalts with subordinate microporphyritic basalts and rare mugearites
Fintry Hills Member (>122 metres) Feldspar-macrophyric olivine basalts with a high proportion of microporphyritic basalts and rare trachybasalts	
Shelloch Burn Member (40–60 metres) Trachybasalts, microporphyritic basalts and feldspar-macrophyric olivine basalts	Lees Hill Member (0–40 metres) Trachybasalts
Spout of Ballochleam Member (24–92 metres) Feldspar-microphyric basalts; Stronend Interbasaltic Beds in middle part	
Slackgun Interbasaltic Member (0–79 metres) Tuff (possibly volcanic detritus), laterites and weathered lavas	
————— Unconformity —————	
Skiddaw Member (0–37 metres) Feldspar-macrophyric olivine basalts and composite basalts	Baston Burn Member (9–67 metres) Feldspar-macrophyric olivine basalts
	Basal Member (30–46 metres) Trachybasalts, feldspar-macrophyric olivine basalts and feldspar-microphyric basalts
Clyde Sandstone Formation	
Fluvial sandstones and conglomerates; some reworked volcanoclastic detritus in upper part	

(Table 2.2) **Succession of the Clyde Plateau Volcanic Formation in the western Campsie Fells.** (After Hall *et al.*, 1998, table 4)

	Lava types	Source
Holehead Lava Member	Mainly feldspar-macrophyric basalt ('Markle type')	Waterhead central volcano
Fin Glen Lava Member	Microporphyritic basalt, mugearite, trachybasalt and a persistent phonolitic trachyte	Local centres and North Campsie Linear Vent System
Upper and Lower North Campsie lava members	Microporphyritic basalt, basaltic lava members hawaiite and hawaiite	North Campsie Linear Vent System

Bedding:



(Table 4.2) Distribution of accidental xenoliths and megacrysts in the East Fife necks (* = fragmental pyrope garnets – the famous, so-called 'Elie Ruby') (additional minor xenocryst phases are listed in the text). (Abbreviations: RP = Ruddons Point; EN = Elie Ness; CH = Coalyard Hill; AR = Ardross.)

Volcanic Neck	RP	EN	CH	AR
Xenoliths				
Hydrated ultramafic rock		•		•
Spinel lherzolite	•		•	
Wehrlite	•		•	
Biotite-amphibole pyroxenite	•		•	
Anorthoclase	•	•		
Pyroxene granofels and gneiss	•			
Quartzo-feldspathic granofels and gneiss		•		
Garnetiferous quartzo-feldspathic granofels and gneiss			•	
Garnetiferous ultramafic rock		•		
Principal megacrysts and xenocrysts				
High-temperature feldspar — mainly anorthoclase	•	•	•	•
Garnet *		•		
Corundum	•			
Zircon		•		

(Table G1) Local nomenclature of basic igneous rocks of Carboniferous and Permian age in Scotland, as used on Geological Survey maps and in most literature since 1928. Now being replaced by more-standard terminology based on dominant phenocrysts and, where possible, the chemical composition. (pl = plagioclase, ol = olivine, cpx = clinopyroxene, fetiox = iron-titanium oxides.)

(Table 2.2) Succession of the Clyde Plateau Volcanic Formation in the western Campsie Fells. (After Hall et al., 1998. table 4)

Lithological units / Necks	LL	VF	RP	KC	CF	CN	EH	EN	WL	AR	CH	NW	DC	DR	SM
Basaltic tuff and agglomerate (bedded)		●	●	●	●		●	●	●	●		●			●
Basaltic tuff and agglomerate (unbedded)	●	●	●	●				●	●	●	●	●	●		●
Basaltic breccia				●			●								
Sediment-derived tuff					●					●	●	●			
Tuffisite breccia			●	●	●	●	●		●	●				●	●
Tuffisite dyke(s)		●	●	●		●		●						●	●
Tuffisite intrusion(s)									●	●		●	●		
Basaltic dyke(s)	●				●		●	●	●	●				●	
Basaltic intrusion(s) (not specified)	●		●	●							●			●	●
Olivine basalt and basanite intrusion(s)						●	●								●
Olivine-dolerite intrusion(s)							●	●							
Sandstone (large xenoliths and rafts)			●	●			●			●	●			●	●
Carboniferous sedimentary rocks	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
Bedding: ●=collapsed;○=centroclinal		●	○	●	○		○	●	○	○					
Marginal ring-faults or shear zones	●	●		●			●				●				●
Cryptovolcanic structures				●	●								●		
Megacrysts and xenoliths			●					●		●	●				

(Table 4.1) Lithological units and features of the volcanic necks between Lundin Links and St Monance, East Fife Coast.

Volcanic Neck	RP	EN	CH	AR
Xenoliths				
Hydrated ultramafic rock		●		●
Spinel lherzolite	●		●	
Wehrlite	●		●	
Biotite-amphibole pyroxenite	●		●	
Anorthoclase	●	●		
Pyroxene granofels and gneiss	●			
Quartzo-feldspathic granofels and gneiss		●		
Garnetiferous quartzo-feldspathic granofels and gneiss			●	
Garnetiferous ultramafic rock		●		
Principal megacrysts and xenocrysts				
High-temperature feldspar – mainly anorthoclase	●	●	●	●
Garnet *		●		
Corundum	●			
Zircon		●		

(Table 4.2) Distribution of accidental xenoliths and megacrysts in the East Fife necks.

Basalt type of MacGregor (1928)	Phenocrysts		Chemical classification after Macdonald (1975)	Type locality
	abundant	may be present in lesser amounts		
Macroporphyritic (phenocrysts > 2mm)				
Markle	pl	± ol, fetiox	pl ± ol ± fetiox-phyric hawaiite, basaltic hawaiite or basalt	Markle Quarry, East Lothian
Dunsapie	pl + ol + cpx	± fetiox	ol + cpx + pl ± fetiox- phyric basaltic hawaiite or ol + cpx + pl-phyric basalt	Dunsapie Hill, Edinburgh (neck intrusion)
Craiglockhart	ol + cpx		ol ± cpx-phyric microbasalt or basanite	Craiglockhart Hill, Edinburgh (flow)
Microporphyritic (phenocrysts < 2mm)				
Jedburgh	pl	± ol, fetiox	pl ± ol ± fetiox-phyric hawaiite, basaltic hawaiite or in some cases basalt	Little Caldon, Stirling- shire (plug). Also in Jedburgh area
Dalmeny	ol	± cpx, pl	ol ± cpx-phyric basalt	Dalmeny Church, West Lothian (flow)
Hillhouse	ol + cpx		ol ± cpx-phyric basalt or basanite	Hillhouse Quarry, West Lothian (sill)

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