

# Minor intrusions, Silurian and Devonian igneous activity, Midland Valley of Scotland

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[Jump to navigation](#) [Jump to search](#)

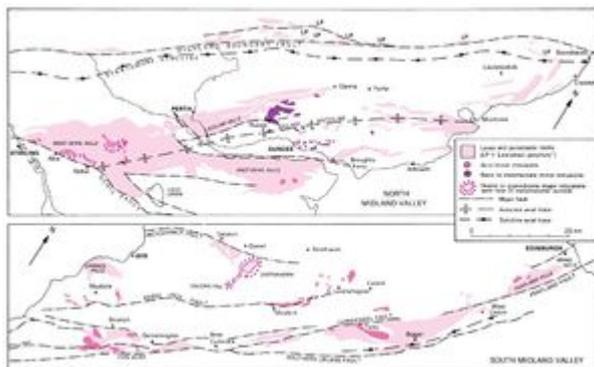
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## Contents

- [1 Dykes and thin sills](#)
- [2 Intrusions of the Dundee area](#)
- [3 'Felsite' sills and laccoliths of the Midland Valley](#)
- [4 Intrusions of the Maybole-Straiton-Dalmellington area](#)
- [5 Bibliography](#)

## Dykes and thin sills



Outcrop of late Silurian and Lower Devonian igneous rocks in the Midland Valley.

P915524.

The majority of minor intrusions exposed in the Midland Valley are closely associated with sequences of Lower Devonian volcanic rocks, where dykes and thin sills are widespread and ubiquitous but rarely abundant. They are seen to cut the volcanic sequence and the underlying sedimentary successions in all areas but are never found in overlying sediments, and are thus regarded as contemporaneous with the volcanic activity. Outside of the areas of known volcanicity, dykes are numerous around the Distinkhorn granodiorite-diorite complex where they cut Lower Devonian sediments and are thermally metamorphosed by the pluton. A few dykes within the aureole have not been metamorphosed and represent a slightly later generation. The only dykes not associated with any known igneous centre cut Lower Devonian and more rarely Silurian sediments of the Lesmahagow Inlier.

The dykes do not exhibit a constant regional trend, although there is a tendency for them to occur in the NE-SW quadrant as in the Pentland Hills. A swarm of dykes in the western Ochils is radially disposed around a group of plutonic intrusions. The majority of dykes are 1 to 2 m in width, although widths up to 6m are common and 25m-wide dykes are recorded in the Ochils. Most are impersistent

laterally or cannot be traced beneath drift cover, but distinctive dykes have been traced for up to 3 km in the Ochil and Pentland Hills.

The majority of dykes are of basic to andesitic composition with close petrographic and geochemical similarities to the lavas. Rock types include olivine-dolerite or basalt, quartz-dolerite, porphyritic microdiorite or andesite (with combinations of plagioclase, orthopyroxene, clinopyroxene, hornblende and biotite phenocrysts), microgranodiorite (with or without quartz and/or albite phenocrysts) and microgranite. Many are highly altered by albitisation, sericitisation, chloritisation, carbonation and silicification such that all traces of primary minerals are obliterated and classification, where possible, is based upon recognition of pseudomorphs and relict textures. The classification employed on Geological Survey maps reflects these difficulties and includes several general terms See table. Distinctions between several of these groups are ill-defined.

<b>Classification of the more common rock-types of Lower Devonian minor intrusions as used in Geological Survey maps</b>		
<b>Name on map</b>	<b>Compositional range</b>	<b>Remarks</b>
<b>Sub-basic and basic, mafic and semi-mafic</b>	Olivine-dolerite/basalt quartz-dolerite	Rarely porphyritic with labradorite or andesine phenocrysts. Commonly severely altered
<b>Microdiorite</b>	Non porphyritic	
<b>Porphyrite and basic porphyrite where differentiated</b>	Hypersthene-, augite- or hornblende-andesite/microdiorite	Porphyritic. Abundant phenocrysts of albitised plagioclase with or without pyroxenes and/or amphibole
<b>Acid porphyrite</b>	Hornblende- or biotiteandesite, trachyandesite, dacite, microgranodiorite	Porphyritic. Abundant phenocrysts of albitised plagioclase with or without hornblende or biotite, rarely pyroxene. Sparse quartz and/or alkali feldspar in groundmass. More leucocratic than porphyrite
<b>Quartz-albite-porphyr and quartz-porphyr</b>	Microgranodiorite/ rhyodacite, microgranite/rhyolite	Porphyritic. Phenocrysts of quartz with albite (primary or albitised) and/or potash feldspar. Biotite usually present
<b>Felsite</b>	Microgranodiorite/rhyodacite, microgranite/rhyolite	Sparsely porphyritic or non porphyritic, fine-grained, often devitrified, compact leucocratic rocks. Usually pink-weathering
<b>Plagiophyre</b>	Mostly andesitic	A locally convenient, vague term for highly altered, sparsely porphyritic to non porphyritic, rocks with albitised feldspar
<b>Lamprophyre</b>	Mostly kersantite	Essential plagioclase and biotite

## **Intrusions of the Dundee area**

Numerous thick sills, laccoliths and bosses cut the Ochil Volcanic Formation of the Sidlaw Hills and the underlying sediments of the Dundee Formation in the core of the Sidlaw Anticline. The largest intrusion is a 100 m-thick sill extending for 7 km from Rossie Hill to Lundie. Other sills and laccoliths can be traced for up to 2 km and bosses averaging 0.5 km in diameter are widespread. An undulating laccolith roof, exposed in the railway cutting east of Ninewells has produced conformable dome and basin structures in overlying sandstones and mudstones.

The intrusions are probably contemporaneous with or immediately post-date the lavas, which they resemble in petrography and geochemistry. Coarse-grained quartz-hypersthene-microdiorite or dolerite ('basic porphyrite') is the most abundant rock type, including the Rossie Hill-Lundie sill and many of the bosses. Ophitic and microporphyritic olivine-dolerite occurs in irregular sill-like bodies in the Sidlaw Hills and in small bosses in Dundee. Porphyritic augite-andesites and hypersthene-andesites occur around Dundee (e.g. Dundee Law and Craigie Hill) and more-acid porphyritic rocks include the biotite-dacite of the Ninewells railway cutting. Other acidic intrusions include albitised porphyritic quartz-trachytes in small sills to the north of Dundee and in more persistent sills along the length of the Sidlaw Hills. Many of the more basic intrusions are cut by segregation veins and diffuse patches of quartzo-feldspathic material.

## **'Felsite' sills and laccoliths of the Midland Valley**

Thick sills and laccolithic intrusions, composed of a variety of fine-grained acid igneous rocks and collectively referred to as 'felsite' and 'acid porphyrite' are abundant in the south of the Midland Valley where they are particularly concentrated in a 6 to 12 km-wide zone on the north-west side of the Southern Upland Fault ([P915524](#)). In the north they are represented by rare dykes and by larger intrusions in the Ochil Hills (e.g. Forret Hill and Lucklaw Hill). The 'felsites' are usually resistant to erosion relative to surrounding rocks and commonly form prominent, rounded hills such as Tinto (near Biggar), Garleffin Fell and Glenalla Fell (near Straiton). They have been extensively quarried for road metal and are a major source of the pink 'felsite chips' characteristic of so many Scottish roads.

The intrusions cut Silurian to Lower Devonian sediments below the Lower Devonian volcanics and the volcanics themselves with little thermal effect. In places they are overlain unconformably by the Upper Devonian or Lower Carboniferous and contribute distinctive pebbles to basal conglomerates. Sills are concordant with the strata or are gently cross-cutting with several leaves ranging in total thickness from 20 to 500m. Larger laccolithic intrusions, characterised by transgressive upper margins, include the mass of Tinto which crops out over 10 km<sup>2</sup> and has an estimated maximum thickness of 1000 m.

Rock-types range from non porphyritic microgranodiorite to porphyritic dacite, rhyodacite (quartz-albite-porphyry and quartz-porphyry) and rhyolites. Biotite microphenocrysts are common and pyroxene and hornblende are found in some sheets. Garnet has been reported from the microgranodiorite of Tinto.

## **Intrusions of the Maybole-Straiton-Dalmellington area**

A group of thick concordant sills of basic to intermediate composition intrude Lower Devonian sediments below the volcanic sequence, to the south and west of Maybole. Similar rock types occur in sills and dyke-like bodies intruded at similar stratigraphic levels to the south of Straiton and Dalmellington. The intrusions consist mainly of highly-altered andesitic rocks ('plagiophyres') and

quartz-dolerites. The latter contain interstitial quartz but no micropegmatite in contrast to the late Carboniferous quartz-dolerites of the Midland Valley (p. 120). Decomposed quartz-free dolerites are less common but there are a few olivine-basalts some of which resemble local lava types. A few lamprophyre sills of limited lateral extent are mostly classed as kersantites.

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[Category:](#)

- [Midland Valley of Scotland](#)

## Navigation menu

### Personal tools

- Not logged in
- [Talk](#)
- [Contributions](#)
- [Log in](#)
- [Request account](#)

### Namespaces

- [Page](#)
- [Discussion](#)

### Variants

### Views

- [Read](#)
- [Edit](#)
- [View history](#)
- [PDF Export](#)

### More

### Search

### Navigation

- [Main page](#)
- [Recent changes](#)
- [Random page](#)
- [Help about MediaWiki](#)

### Tools

- [What links here](#)

- [Related changes](#)
- [Special pages](#)
- [Permanent link](#)
- [Page information](#)
- [Cite this page](#)
- [Browse properties](#)

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