

# Precambrian, Palaeogene volcanic districts of Scotland

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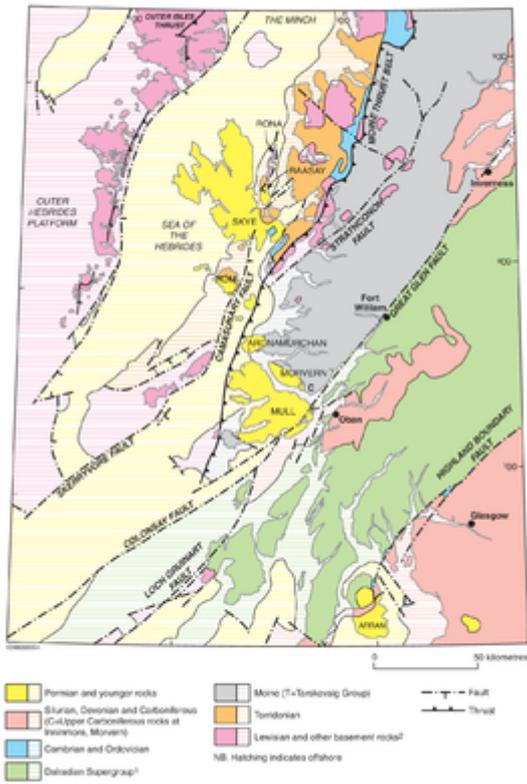
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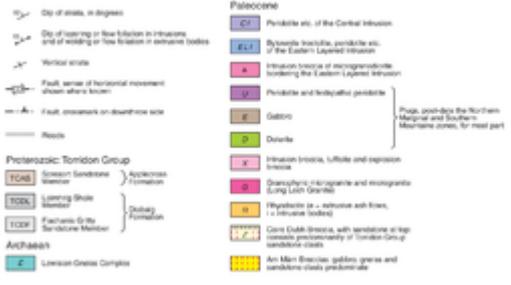
## Pre-Mesozoic



Precambrian and Lower Palaeozoic rocks in the district. P914121



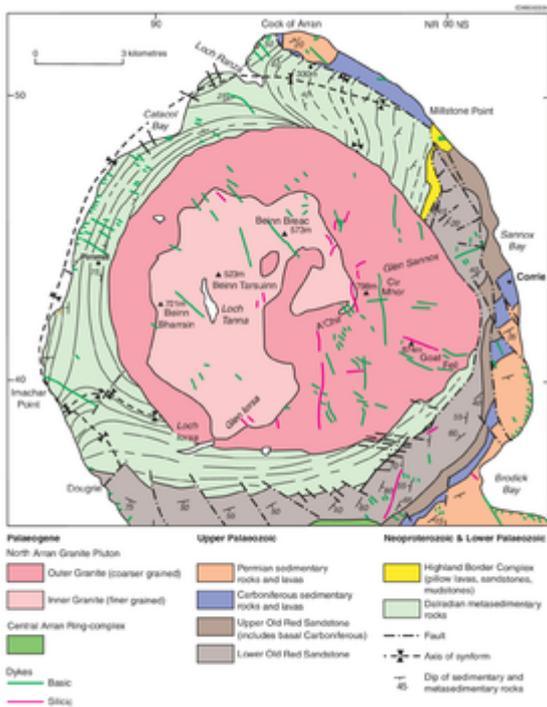
Lewisian granodioritic gneisses, near Priomh-lochs, Rum. P698898



Northern Marginal Zone, Rum Central Complex. P914143



Torridonian strata on Mullach Mór, Rum. P580458



## North Arran Granite Pluton. P914151

The general distribution of Pre-Mesozoic rocks in the western Highlands and Islands of Scotland is shown in [P914121](#). A brief account of the rocks where they are closely associated with the Palaeogene igneous rocks is given here; but more detailed information can be found in Johnstone and Mykura (1989).

## Archaean

Outcrops of the Lewisian Gneiss Complex are widespread in the northern part of the Hebridean Province where the principal occurrences are on Skye and the nearby islands of Raasay and Rona. The granodioritic, tonalitic and doleritic intrusive rocks from which the gneisses formed were intruded into lower crustal levels at about 3100 to 2800 Ma. Gneiss formation accompanied by granulite-facies metamorphism occurred in the Archaean prior to 2500 Ma, marking the Scourian Event (Friend and Kinny, 2001). Intrusion of a suite of basaltic dykes, the Scourie Dyke Swarm, occurred mainly about 2400 Ma. This was followed by pervasive deformation and amphibolite-facies metamorphism during the Laxfordian Event that peaked about 1700 Ma. Later retrogression, movement along shear zones and formation of crush belts occurred periodically during uplift and exhumation of the gneiss complex up to about 1100 Ma (Park, 1991; Park et al., 1994).

## Skye, Rona and Raasay

High-grade, felsic, biotite-hornblende gneisses with mafic and ultramafic bands, lenses and clots formed during the Scourian Event and crop out extensively on Raasay north of the Screapadale Fault and throughout all of Rona. These gneisses were strongly reworked by the Laxfordian Event and are similar to those found in the Torridon area of the mainland. On Skye, the most extensive area of Lewisian gneisses occurs on the south-east side of the Sleat peninsula. These rocks are on the western edge of the Caledonian fold-belt and have been overthrust to the west-north-west, as part of the Moine and Tarskavaig thrust sheets. They consist of sheared and retrograde gneisses with

prominent amphibolite and zoned ultramafic pods. Near Isle Ornsay and on the shores of Loch na Dal, the mafic gneisses locally contain garnet porphyroblasts, and both mafic and felsic gneisses are overprinted by needle-like crystals of actinolite up to 5 cm in length. In the west, around Tarskavaig, thin, mylonitised layers of Lewisian-like gneiss crop out close to some thrust planes. In the Eastern Red Hills Centre, gneisses unconformably overlain by Paleocene lavas crop out on Creagan Dubh (Bell and Harris, 1986), and large xenoliths of gneiss are present in the Marsco Hybrids in the Western Red Hills Centre (Wager et al., 1965; Thompson, 1969). The more felsic components of gneisses enclosed in the Marsco Hybrids have been partially melted, as have the gneiss xenoliths present in a dolerite intrusion next to Loch Sligachan.

## **Rum**

Gneisses crop out at several localities, which lie either within the central or western parts of the central complex ([P698898](#)) or along the peripheral Main Ring Fault system ([P914143](#)). These gneisses, together with the Torridon Group that overlies them unconformably, were uplifted by as much as 2 km during the Paleocene igneous activity. The more mafic components in the gneisses are commonly altered to two-pyroxene hornfelses, whereas the leucocratic gneisses show varying degrees of partial melting. Gneiss clasts are common among the inter-lava conglomerates of the Canna Lava Formation of north-west Rum, but these have not been affected by thermal metamorphism to the same extent as those found at outcrop in the central complex.

In the central complexes of Skye and Rum, gneisses are exposed at present, either because of doming and uplift due to igneous activity or because of faulting. The outcrops provide clear proof that these areas are underlain by the Lewisian Gneiss Complex, thus corroborating geophysical (seismic) evidence.

## **Torridonian**

Thick sequences of undeformed, non-metamorphosed late-Proterozoic clastic sedimentary rocks that overlie Lewisian gneisses are known collectively as the Torridonian (succession). In the northwest Highlands, the lowest, Stoer Group is separated from the overlying Sleat and Torridon groups by a major unconformity that possibly represents a time-gap of over 200 Ma. Only the two younger groups crop out in the northern Inner Hebrides and their local successions are summarised in Table 1 (Stewart, 1991; Nicholson, 1993). The age of the Torridon Group is constrained by whole-rock Rb-Sr dates of  $994 \pm 48$  Ma on phosphatic concretions in the Diabaig Formation and  $977 \pm 39$  Ma on siltstones in the Applecross Formation (Turnbull et al., 1996). The youngest detrital zircons in the Applecross Formation have a U-Pb date of  $1060 \pm 18$  Ma (Rainbird et al., 2001).

## **Skye**

Rocks of the Torridon Group crop out around the margins of the Eastern Red Hills Centre, for example south of Broadford, at Dunan and on the islands of Scalpay and Raasay. In addition, there are outcrops on Soay, at Camasunary, and along the north side of Soay Sound. They are generally red-brown feldspathic sandstones, commonly pebbly, and typical of the Applecross Formation. An extensive tract of Torridonian strata occurs in south-east Skye (Sleat) ([P914121](#)), and in isolated north-west-overthrust sheets in the vicinity of Broadford. The lowest strata belong to the Sleat Group and consist of greyish green, grey and buff gritty sandstones, commonly epidote-bearing, together with siltstones and sandy laminated siltstones. They total over 3000 m in thickness and occur in a belt up to 7 km in width stretching from the shores of Loch Alsh east of Kyleakin, south-

west along the Sleat peninsula to the vicinity of Armadale. Overlying them, west of a line from about Ord to Kyleakin, are brownish red, false-bedded feldspathic sandstones of the Applecross Formation. The Torridonian strata in south-east Skye lie within the Kishorn Thrust Sheet of the Moine Thrust Belt and are much affected by faulting and thrusting, especially on the Sleat peninsula (Johnstone and Mykura, 1989).

#### Torridon and Sleat groups on Rum and Skye

	<b>Rum</b>	<b>Skye</b>	
	Sheet 60 Rum, 1994	Sheet 71W Broadford, 2002	
	Foreland	Foreland	Kishorn Thrust Sheet
	AULTBEA FORMATION	AULTBEA FORMATION	
	Sgorr Mór Sandstone Member		
	APPLECROSS FORMATION	APPLECROSS FORMATION	
	Scresort Sandstone Member	Leac nam Faoileann Member	
<b>TORRIDON GROUP</b>	Allt Mór na h- Uamha Member	Bheinn Bhreac Member	
		Leac-stearnan Member	
		Sithean Glac an Ime Member	APPLECROSS FORMATION
	DIABAIG FORMATION	DIABAIG FORMATION	
	Laimhrig Shale Member	Mullach na Carn Member	
	Fiachanis Gritty Sandstone Member	Sgurr na Stri Member	
		Bla-bheinn Member	
<b>SLEAT GROUP</b>			KINLOCH FORMATION
			BEINN NA SEAMRAIG FORMATION

#### Rum

Rocks of the Torridon Group crop out in the north and east of the island where a thick succession (over 3000 m) of brown, feldspathic sandstones and pebbly sandstones belonging to the Applecross Formation is preserved (Table 1). Within the formation, the contrasting weathering of coarse- and fine-grained beds, alternating on a scale of one to ten metres, gives a distinctive landscape in the north of the island, comprising long westward-dipping crags and intervening peaty shelves ([P580458](#)). Tabular sandstone bodies in the Applecross Formation are interpreted as sandbars in a braided river system, comparable with present-day examples (e.g. Nicholson, 1993). Pale grey silty sandstones and siltstones that occur towards the base of the succession are assigned to the Diabaig Formation (Table 1). Within the central complex, these fine-grained rocks are interbedded with sedimentary breccias and coarse-grained gritty sandstones, and lie unconformably on an irregular surface of Lewisian gneisses. At the top of the succession, fine-grained sandstones, commonly with heavy-mineral concentrations, are assigned to the Aultbea Formation.

## Moine Supergroup

A thick succession of medium- to fine-grained clastic sediments, deposited in shallow seas, has been lithified and metamorphosed to form the pelitic, semipelitic and psammitic rocks of the Moine Supergroup. In the Glenelg area, east of Skye, Moine metasedimentary rocks overlie Lewisian gneisses. The actual date of sedimentation has not been precisely determined. However, gneissose granite, dated at about 1083 Ma, cuts Moine rocks, and it has been suggested that the latter were deposited up to 200 million years earlier (Harris and Johnstone, 1991). Rocks of the Moine Supergroup crop out extensively throughout the North West Highlands (Johnstone and Mykura, 1989) and the few occurrences in the Hebridean Province are briefly described below.

### Skye

Psammitic, semipelitic and pelitic rocks crop out between the Kishorn and Moine thrust planes on the Sleat peninsula of Skye ([P914121](#)). They are intermediate in character between the Torridonian rocks in the Kishorn Thrust Sheet to the west and the rocks of the Moine Supergroup that overlie the Moine Thrust to the east, but are distinctly less metamorphosed than the latter. They have been termed the Tarskavaig Group, after the type-locality on the west side of Sleat, and are described more fully by Johnstone and Mykura (1989).

### Ardnamurchan and Morvern

Mildly metamorphosed pebbly sandstones, sandstones and silty sandstones of the Morar Group of the Moine Supergroup are present in and around the Ardnamurchan Central Complex. They also underlie the Palaeogene lavas and Mesozoic rocks on Ben Hiant and on the Morvern peninsula. Higher grade psammitic rocks with granite veining, belonging to the Glenfinnan Group, underlie and crop out along the eastern edge of the lava pile on Morvern.

### Mull

Rocks of the Glenfinnan Group are found at many localities around the margins of the Mull Central Complex, for example in the core of the Craignure Anticline and beneath the Mesozoic rocks on the coast south of Gribun. Screens of Moine rocks occur between inclined sheets and other minor intrusions in eastern Mull. Outside of the Mull Central Complex, fragments of Moine lithologies, including megablocks up to 100 m across, are common in vent infills and in other volcanoclastic rocks (Bailey et al., 1924, fig. 29). Numerous xenoliths of severely altered Moine rocks are present in the Loch Scridain Sill-complex. On the Ross of Mull, Moine rocks, possibly of both the Glenfinnan and Morar groups, crop out south of the Loch Assapol Fault where they are intruded by the late-Caledonian, Ross of Mull Pluton. From the distribution of rocks of the Moine Supergroup on Mull, it is evident that the central complex is underlain by, and intruded into, these rocks.

## Dalradian Supergroup

Rocks belonging to the Dalradian Supergroup occupy much of the ground between the Great Glen Fault and the Highland Boundary Fault ([P914121](#)), but only on Arran are they a major part of the country rocks to Palaeogene intrusions.

## Mull

Grey phyllitic to slaty semipelite and black metalimestone belonging to the Appin Group (possibly the Blair Atholl Subgroup) of the Dalradian form the core of the Loch Don Anticline in eastern Mull. They are separated from Moine rocks on Mull by a continuation of the Great Glen Fault.

## Arran

Low-grade (chlorite zone) gritty and pebbly metasandstone, with subsidiary slaty metasiltstone and metamudstone, of the uppermost Southern Highland Group occupy much of the northern part of the island. They were displaced and folded during the emplacement of the Paleocene North Arran Granite Pluton ([P914151](#)) and are overlain by, or are in faulted contact with, younger rocks to the east. The original strata consisted of a sequence of turbidite deposits, and many of the original sedimentary structures are still preserved, thus aiding interpretation of Paleocene and earlier folding events.

## References

### [Full reference list](#)

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