SKOMER ISLAND

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Introduction

Skomer Island, off the coast of Pembrokeshire, is composed almost entirely of volcanic and related rocks of Llandovery age (Figure 6.69). The volcanic rocks are chiefly basic in composition, with rarer intermediate and silicic rocks. They are mainly of extrusive origin, or relate to the intrusion of magma at a high level; a small proportion are pyroclastic. Rarer sedimentary rocks within the sequence reflect periods of volcanic quiescence. These sedimentary beds provide important palaeogeographical evidence for the setting in which the volcanism took place. The Skomer Island GCR site is of national importance in that it provides excellent exposures of the youngest major volcanic episode in the southern part of the British Caledonides.

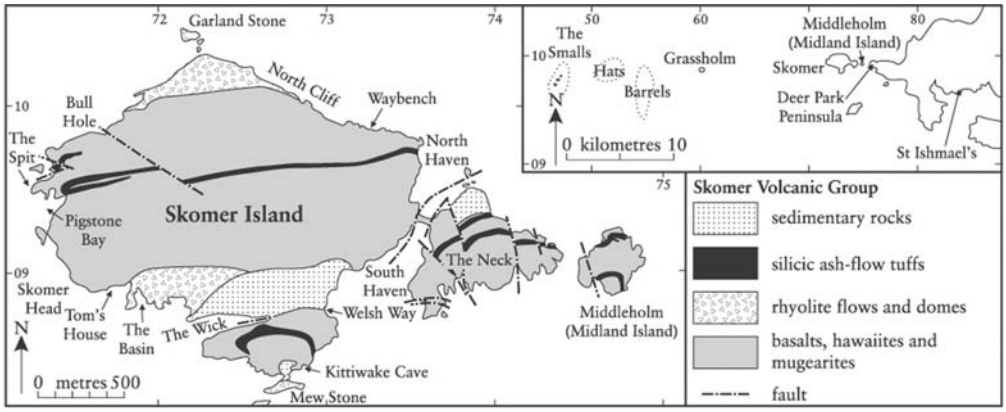

Figure 6.69: Map of Skomer Island (after Ziegler et al., 1969).

The volcanic rocks are also exposed farther west on Grassholm, on the shoals known as the Hats and Barrels, and on the Smalls (Figure 6.69). To the east they are exposed on Middleholm (Midland Island) (Figure 6.70), on the Deer Park Peninsula, where crucial evidence for the age of the Skomer Volcanic Group is seen at Renney Slip (see theDeer Park GCR site report), and extending as far as St. Ishmael's. In all there is an E–W extent of some 43 km of the Skomer volcanic rocks. Clearly, this sequence represents the remnants of a major volcanic field which developed in the southern part of the Welsh Basin during early Silurian times.

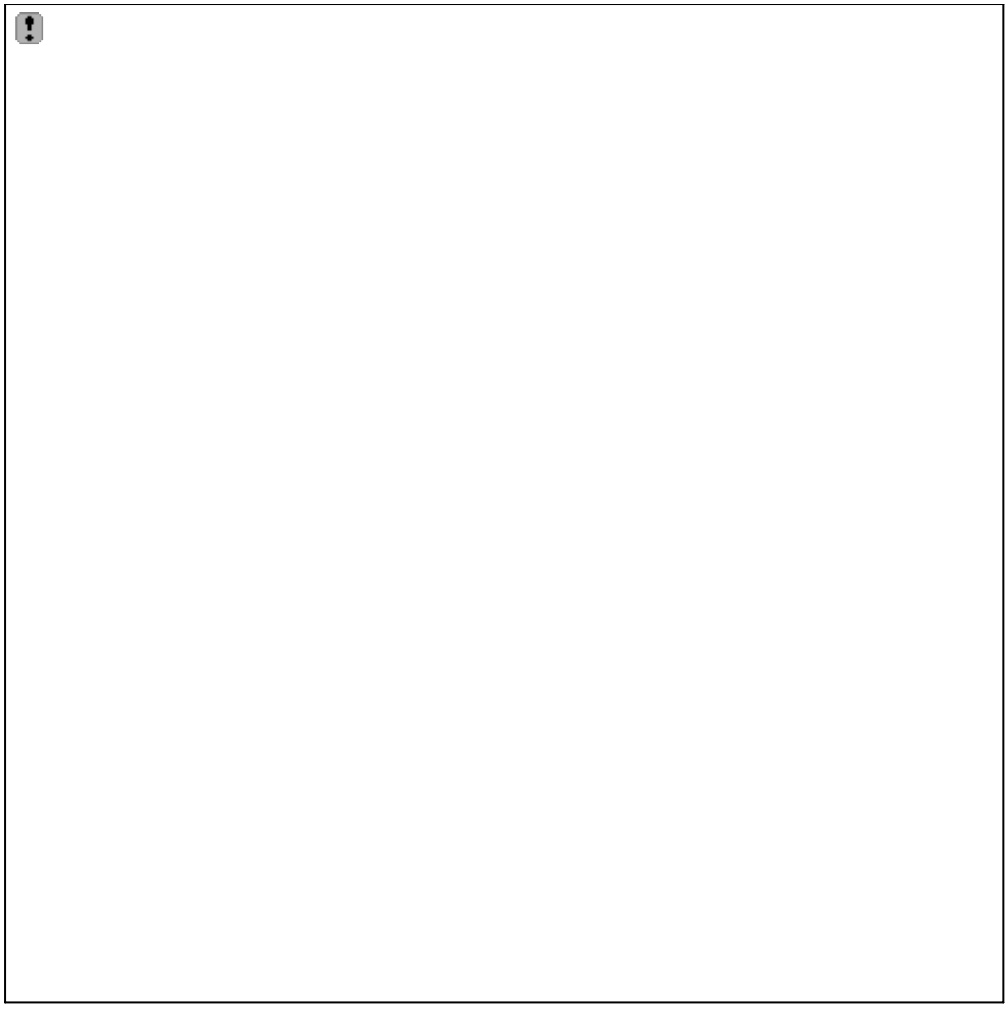

Figure 6.70: Oblique aerial view of Skomer Island from the NW, with Middleholm (Midland Island) and the Deer Park Penisula behind. Both islands are made up chiefly of basalts, hawaiites and mugearites of the Skomer Volcanic Group. (Photo: S. Howells.)

The earliest, brief, accounts of the volcanic and related rocks of Skomer Island were presented by Howard and Small (1896a, 1896b, 1897), while the first major report was that by Thomas (1911). Further reference to the sequence appeared in the Geological Survey memoir to the district around Milford Haven (Cantrill *et al*., 1916). In all of these accounts, the age of the Skomer volcanic rocks was thought to be Ordovician (Arenig). It was the detailed stratigraphical investigation of Ziegler *et al*. (1969) that established the true age of the sequence as Silurian (Llandovery); they re-examined the Skomer volcanic rocks and their associated sedimentary rocks, concluding that in fact they grade laterally and pass vertically into rocks of early Silurian age. Poorly preserved ostracodes from Middleholm (Midland Island) also argue against an Arenig age for the Skomer volcanic rocks, as does a consideration of structural relationships at Musselwick, on the Marloes Peninsula, where the Skomer volcanic rocks are apparently downthrown against sedimentary rocks of Llandeilo age (Ziegler*et al*., 1969).

Thomas (1911) provided preliminary geochemical data for the Skomer volcanic rocks; these data were elaborated on by Ziegler *et al*. (1969) who provided, in particular, analyses of a unit termed the ‘Skomer Ignimbrite'. Hughes (1977) and Fitton *et al*. (1982) presented additional geochemical data, while the most recent geochemical investigations are those ofThorpe *et al*. (1989). These last authors presented new major and trace element analyses for basic and acidic volcanic rocks from the area, concluding that in the main they are related by crystal fractionation. In addition, they reported that the silicic rocks could be divided into two unrelated groups, a high-Zr peralkaline group and a low-Zr group.

Description

Ziegler *et al*. (1969) adopted the term Skomer Volcanic Group for the thick volcanic succession exposed on Skomer Island and in the adjacent region, although no formal stratigraphical subdivision of the Skomer volcanic rocks has been established. In the absence of such, the sequence is described on the basis of field exposures, from the exposed base to the exposed top. Descriptions are predominantly of the coastal outcrops, in particular those along the eastern and southern cliffs, exposure inland being relatively scant and of inferior quality.

On Skomer Island, the effusive and tuffaceous rocks form up to 760 m of the exposed section, with interbedded sedimentary rocks representing an additional 140 m. The various units dip consistently to the SSE at around 20° to 30°. The oldest rocks exposed, therefore, are the silicic ash-flow tuffs of the Garland Stone and adjacent areas on the north coast, while the youngest are the rhyolites of the Mew Stone in the south.

The Garland Stone rocks were called ‘soda-rhyolites' and ‘soda-trachytes' byThomas (1911). There is probably more than one unit in this section, with a composite thickness of around 130 m. In the field they are typically dark-grey in colour, locally show banding and are spherulitic in parts. They contain plagioclase feldspar (albite) crystals, along with minor Fe-Ti oxides, set in a fine-grained quartzo-feldspathic matrix. In places, shards, and pumiceous and lithic lapilli are present, set in a matrix which shows a well-developed eutaxitic texture.

To the south, as far as Tom's House on the west coast and South Haven on the east coast, a thick sequence (up to 385 m in total) of grey to greenish-grey hawaiite to mugearite lava flows is intruded by thin doleritic sheets. Both flows and sheets are particularly well exposed along the west coast of the island, for example in the vicinity of Skomer Head. The lavas form thin units, typically 5 m in thickness, separated by thin red scoriaceous layers. Very rarely, the flows show pillowed forms, for example on the north coast to the SE of the Garland Stone. In thin section, the lavas show variable degrees of alteration, some showing only very minor development of sericite in plagioclase coupled with groundmass recrystallization. They are sparsely porphyritic, with plagioclase, olivine, clinopyroxene and Fe-Ti microphenocrysts, set in a fine-grained groundmass chiefly composed of plagioclase and commonly showing a flow texture. Some flows show glomeroporphyritic clusters of olivine and plagioclase.

Within the above section thin layers of silicic rock occur, for example at Bull Hole, to the north of The Spit, and at Pigstone Bay. The layer at Pigstone Bay is up to 7.5 m thick at its maximum development; the rocks are fragmental, and contain randomly orientated pumice lapilli, whole and broken crystals and pseudomorphs after glass shards. Minor amounts of accessory minerals are present, including monazite and zircon. Fragmental, silicic rocks are also exposed on the eastern side of the island, in the vicinity of Waybench, which contain coarse lithic fragments, some of which are vesicular, associated with broken feldspar crystals.

To the east of Tom's House, extending as far as The Wick, a spectacular silicic sequence known as The Basin Rhyolite is excellently exposed. These rhyolitic rocks, which reach a maximum thickness of 77 m but thin dramatically over a distance of only 400 m, show magnificent flow-banding and flow-folding, but are perhaps best renowned for the extreme development of nodules, described originally byRutley (1885b). The nodules, which show spherulitic forms, are best developed in the vicinity of The Basin, where they reach up to 25 cm in diameter and commonly occur in layers (Figure 6.71). The rhyolites show alternating light and dark bands on the millimetre scale, with small spherulites developed preferentially in the darker bands. In addition to the predominant spherulitic texture, the rhyolites sporadically show a snowflake texture. The rocks are almost entirely aphyric, with only very rare lithic lapilli and even rarer plagioclase microphenocrysts. Monazite and xenotime are present in very minor amounts, typically occurring as crystals 2–30 microns across.

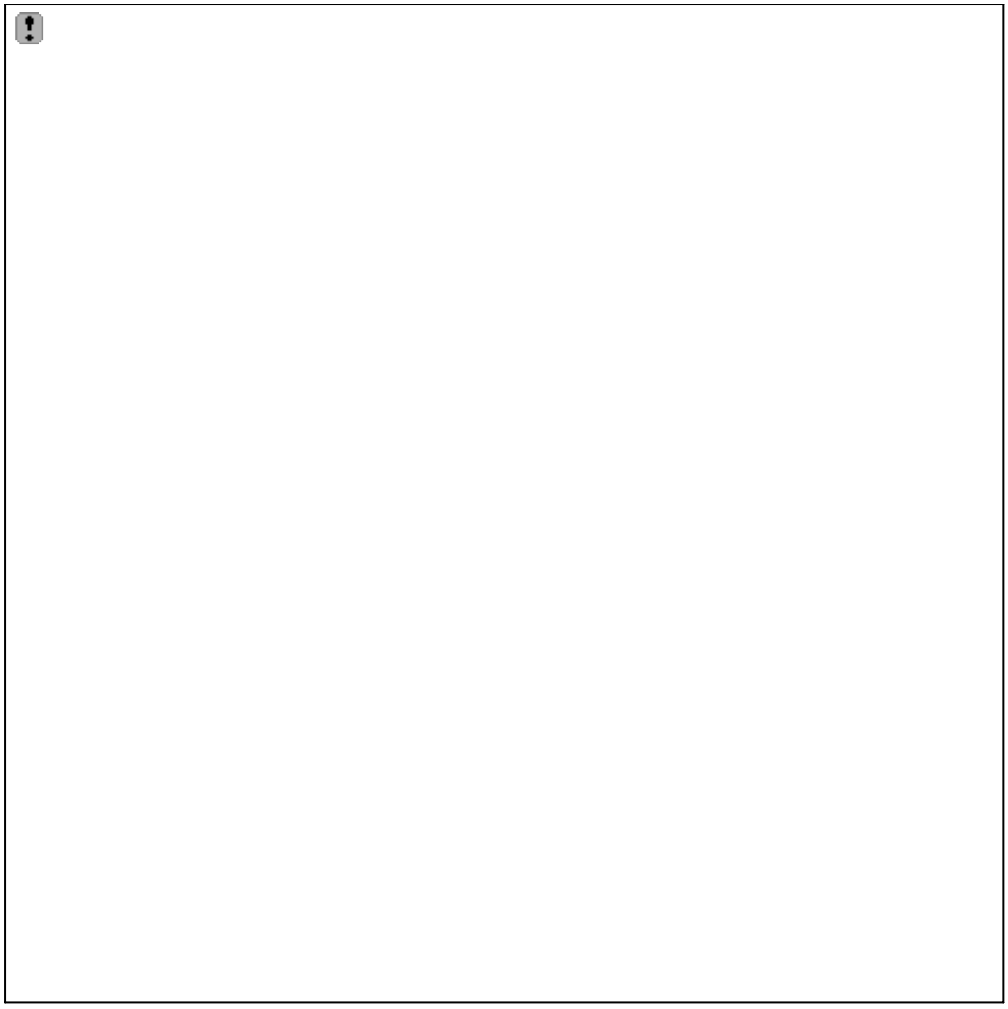

Figure 6.71: Spherulites (up to 10 cm across) in The Basin Rhyolite, Skomer Volcanic Group, The Basin, Skomer Island. (Photo: R.E. Bevins.)

To the east of The Basin, occupying the low-lying ground of The Wick eastwards to Welsh Way, is an intraformational sedimentary sequence described byBridges (1976). To the south, and overlying these sedimentary rocks, are a further 74 m of hawaiite and mugearite lavas; a spectacular section through these lavas is seen to the south of The Wick. Within this succession of lavas is a distinctive red silicic tuff, up to 6 m thick, known as the Skomer Ignimbrite. This unit can be traced across the peninsula, cropping out on the east coast at Kittiwake Cove. It can then be traced across the Neck, onto Middleholm and as far as the Deer Park Peninsula, providing an important stratigraphical marker (Ziegler*et al*., 1969). Microscopically, it shows elongate pumice fragments, lithic clasts and fiamme (up to 5 cm in length) in a recrystallized matrix with a well-developed eutaxitic texture.

The top of the section on Skomer Island is represented by the flow-banded silicic rocks of the Mew Stone. These rhyolites are up to 55 m thick, display excellent flow-folds on the northern face and show a crude columnar-jointing in the upper part of the exposed section. They are sparsely porphyritic and show well-developed perlitic textures, particularly at the base.

Interpretation

The Skomer volcanic sequence is dominated by relatively thin, uniform lava flows showing considerable lateral extent and reddened tops and bases. Ziegler *et al*. (1969) considered these to be subaerial flows, which were non-explosive in character, and did not result in the generation of any significant topography. Locally, however, lavas were either erupted under or emplaced into water, as evidenced by the rare occurrences of pillowed flows. Such flows are found near the top and at the base of the sequence and so there is no simple story of the gradual emergence or submergence of a volcanic island.

The silicic rocks show a variety of forms related to contrasting modes of eruption and emplacement. The rhyolitic lava exposed around The Basin thins dramatically over a short distance, and is thought to represent the remnants of a steep-sided extrusive flow-banded and flow-folded obsidian dome. The rhyolitic rocks exposed in the south, at the Mew Stone, are also thought to represent a thick, extrusive flow, although whether it represents a single flow or a compound set of flows is not certain. In contrast, the silicic tuffs exposed, for example, at Pigstone Bay and on the headland to the south of The Wick are relatively thin (up to 7.5 m maximum thickness) but are laterally extensive. These tuffs are recognized as being ash-flow tuffs, and show both welded and non-welded varieties. The silicic rocks exposed in the north of the island, in the vicinity of the Garland Stone, appear composite and possibly comprise both rhyolitic lava flows and ash-flow tuffs. All of the silicic rocks were apparently emplaced in a subaerial environment, although Ziegler *et al*. (1969) considered that The Basin Rhyolite formed a volcanic island which was subject to erosion in a coastal environment.

Thorpe *et al*. (1989) presented the most recent geochemical data for basic, intermediate and silicic volcanic rocks from the Skomer Volcanic Group. They concluded that the basic to intermediate lavas are hawaiites and mugearites belonging to an alkaline series. Two groups of rhyolites were discriminated, however, a low-Zr group and a high-Zr (peralkaline) group. Silicic rocks from Pigstone Bay and The Basin Rhyolite belong to the low-Zr group, while silicic rocks from the Garland Stone and the Skomer Ignimbrite belong to the high-Zr group.Thorpe *et al*. (1989) considered that rocks of the high-Zr group were derived from the hawaiites and mugearites as a result of low-pressure fractional crystallization, and relate to a basalt–hawaiite–mugearite–comendite series such as is seen in within-plate oceanic and continental settings. The low-Zr group, however, they considered to be unrelated to the other volcanic rocks exposed in the area, although recent unpublished work contradicts that view, linking their generation to the high-Zr group by crystal fractionation involving minor mineral phases, in particular monazite and xenotime (R.E. Bevins and G.J. Lees, unpublished data). The consensus is that the parental magmas were derived from a within-plate ocean-island mantle source which had been modified by earlier subduction-related events.

Conclusions

The Skomer Island site is of national importance in that it provides excellent exposures of the youngest major volcanic episode in the southern part of the British Caledonides. The volcanic rocks show geochemical features which suggest that their source rocks were influenced by earlier Caledonian subduction events.

A range of volcanic rocks, ranging from basic through intermediate to acidic compositions, are excellently exposed on Skomer Island, especially in the rugged cliffed coastline. The basic to intermediate rocks originated chiefly as subaerial flows, although rare pillowed flows show the local occurrence of subaqueous flows. The silicic rocks appear to be entirely of subaerial origin, and were generated in part as extrusive flows resulting in steep-sided domes, and in part from explosive eruptions, leading to the generation of ash-flow tuffs. The age of these various volcanic rocks is provided by their relationship to fossil-bearing sedimentary rocks on the mainland, which indicates a Llandovery age.

Geochemically, two distinct groups of silicic rocks have been determined, a low-Zr group and a high-Zr group. The latter are thought to be related to the basic to intermediate lavas through crystal fractionation, while the low-Zr group rocks have been considered to be unrelated to any of the other volcanic rocks exposed, although recent work suggests a link to the high-Zr group through crystal fractionation. The volcanic rocks are alkaline in character, and were apparently derived from a within-plate mantle source.

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