TURNBERRY LIGHTHOUSE TO PORT MURRAY

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OS Grid Reference: NS196072–NS207081

Introduction

A down-faulted inlier of Lower Old Red Sandstone andesites crops out along the shore between Turnberry Point and Port Murray just south of Maidens Harbour (Figure 9.34). The lavas form the southernmost part of the Carrick Hills volcanic sequence and overlie a Lower Old Red Sandstone sedimentary sequence. A general description of the overall sequence is given in the Port Schuchan to Dunure GCR site description. Geikie (1897) identified 30 andesite flow-units within the Turnberry section that have been re-interpreted as sill-like intrusions into wet sediment (Kokelaar, 1982). The andesites crop out along the coast forming the wave-cut platform and low cliffs below the raised beach terrace. Inland exposures are masked by raised beach deposits.

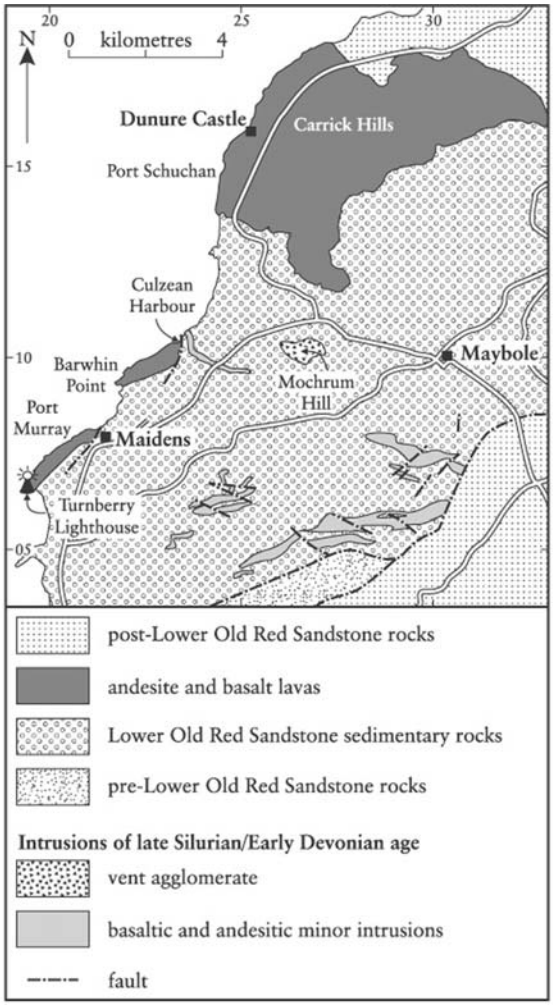

Figure 9.34: Map of the Ayrshire coast outcrops of Lower Old Red Sandstone volcanic rocks.

Description

The lowest part of the section is exposed just south of Turnberry Lighthouse (1960 0718) where two andesite sheets occur, separated by a thin zone containing fine-grained sandstone. The pillowed base and brecciated top of one vesicular andesite intrusion is seen on the wave-cut rock platform in the bay immediately south of the lighthouse. The brecciated andesite

fragments at the upper contact are locally dispersed within the sandstone, a structure which is known as peperite. The overlying andesite sheet forms the low cliff beneath the lighthouse. The base of this sheet is strongly pillowed and the andesite is partially autobrecciated within the intrusion.

The sequence of broadly similar andesites intruded into fine-grained sandstones continues north-eastwards along the coast. At the southern end of Broad Sands to the east of Castle Port (1978 0728), a strongly amygdaloidal andesite exposed towards the top of the beach, is particularly rich in agates. Sandstone dykes up to 20 cm thick conspicuously cut another andesite sheet exposed in the centre of Broad Sands Bay (1989 0738). The sandstone dykes are interbranching and follow a meandering path through the andesite as seen in horizontal section.

Finely laminated red sandstone is exposed in the northern part of Broad Sands Bay and the northern edge of the bay is defined by a low cliff where an andesite sheet cuts into the sandstone (1993 0753). The andesite sheet has a partially pillowed base and there is local development of a breccia with 10 cm fragments of andesite now supported in a bleached pale-yellow sandstone. The lower 50 cm of the andesite has also been bleached to a pale-grey colour.

Good examples of sandstone-filled joints (sandstone ‘dykes') and finely laminated sandstone inclusions within andesite are exposed on the wave-cut platform to the east of the low sea stack Yellow Craig (1997 0760). A rather decomposed enstatite andesite occurs at Cross Ports (Tyrrell, 1913). Just to the SW of John o'Groats Port the strongly vesiculated and pillowed base of a 7–8 m-thick andesite intrusion has been described and figured by Kokelaar (1982, fig. 2) as a typical example of the upper and lower contact features of a moderately thin andesite intrusion into wet unconsolidated sandstone. The base of the sheet, although broadly conformable with the underlying sandstones, is highly irregular with numerous lobate protrusions into sandstone and detached, rounded, more or less irregular pillows. Peperites occur in this basal zone, comprising dispersed andesite fragments within the structureless sandstone. The massive central part of the andesite intrusion is well jointed and some of the joints are filled with sandstone forming sandstone ‘dykes'. The upper contact zone is marked by more in-situ hyaloclastite with numerous andesite fragments and detached pillows supported in a structureless sandstone matrix, above which laminated red sandstone is present.

At John o'Groats Port (2030 0777) andesite and sandstone are mixed in a complex way where an andesite sheet lenses out into sandstone (Geikie, 1897; Kokelaar 1982, figs 3A and 3C).

In the upper part of the Turnberry Lighthouse to Port Murray section, the andesite sheets commonly show pillowed zones. Well-developed pillow structure is seen in a sparsely porphyritic pyroxene andesite south of John o'Groats Port (Figure 9.38). The surface of the pillows exposed on the wave-cut platform has a metallic light-brown patina and the surface of individual pillows is crazed with a network of fine joints. A pyroxene andesite with olivine occurs at John o'Groats Port and two flows of augite andesite occur at Port Murray (Tyrrell, 1913). Just south of Port Murray (around 2058 0792) the lower part of an andesite sheet is highly vesicular and encloses a considerable amount of sandstone in irregular patches or as sandstone-filled amygdales. A 15 cm-wide circular inflation structure, conspicuous in the wave-polished rock surface at the top of the beach, is presumably the result of the expansion to steam of water enclosed within the sediment. Immediately adjacent to this an irregular fragment of sediment has been vesiculated following enclosure within the andesite (Figure 9.39, and see Kokelaar, 1982, fig. 3D). The vesicles in the pale-green sandstone fragment are now filled by calcite.

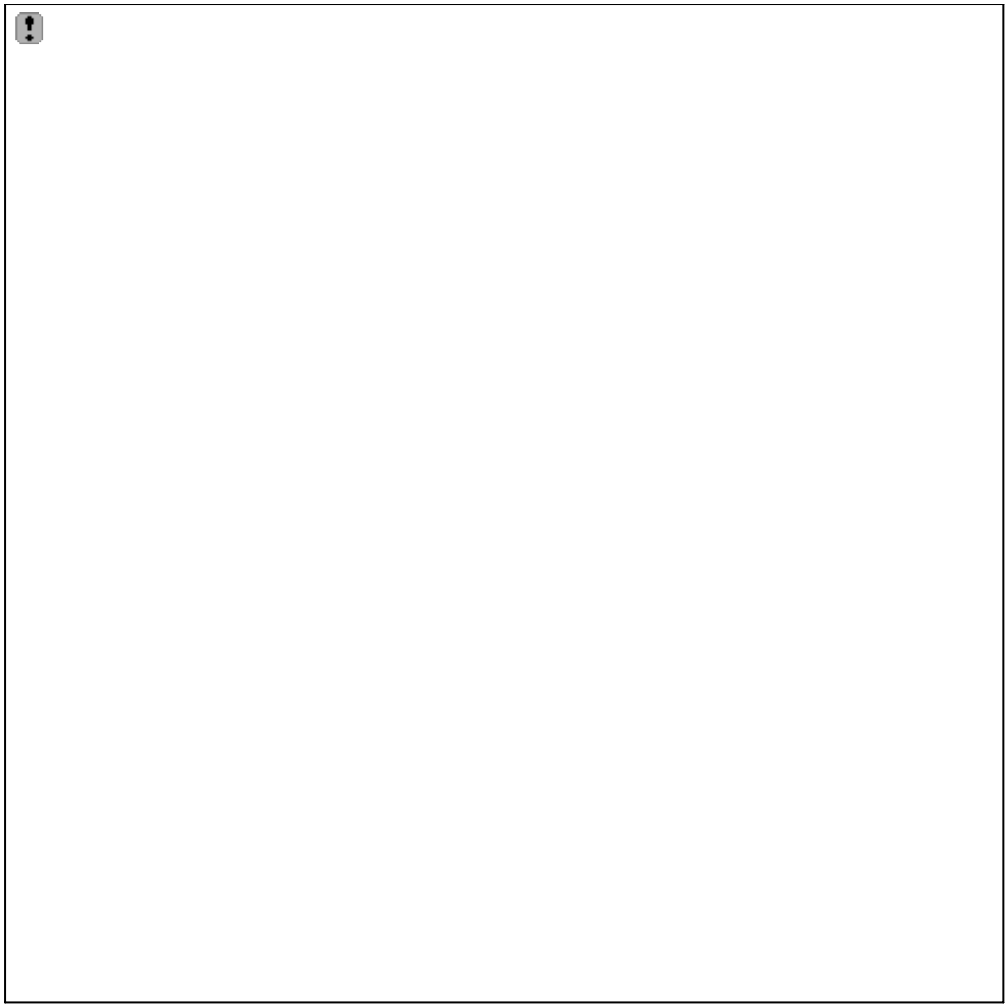

Figure 9.38: Pillow structure in sparsely porphyritic pyroxene andesite south of John o'Groats Port (NS 2032 0780), Turnberry Lighthouse to Port Murray coast section. (Photo: G. Durant.)

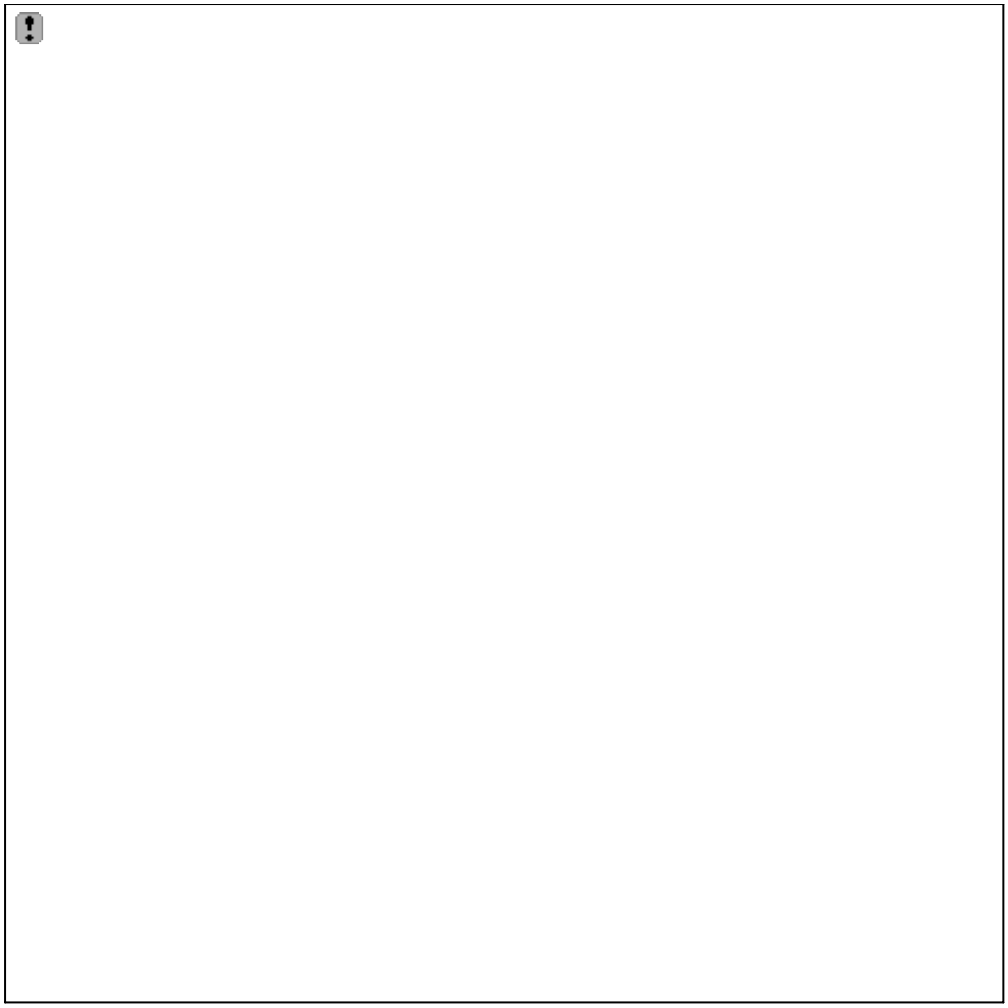

Figure 9.39: Inclusion of vesiculated sandstone in porphyritic andesite, Port Murray (NS 2058 0792). (Photo: G. Durant.)

On the northern side of Port Murray the partially pillowed base of an andesite sheet is well exposed at low tide. Immediately to the east of the disused slipway near Maidens at the northern end of the GCR site (2087 0810) a granular-textured vesicular andesite intrusion shows well-developed hexagonal jointing. At the upper contact of this intrusion the joints have opened up to allow a significant amount of sediment to penetrate between joint blocks in the andesite (Figure 9.40). The andesite is also brecciated locally and a striking rock occurs where the angular blocks (up to 15 cm) of strongly vesiculated andesite are set in purple sandstone.

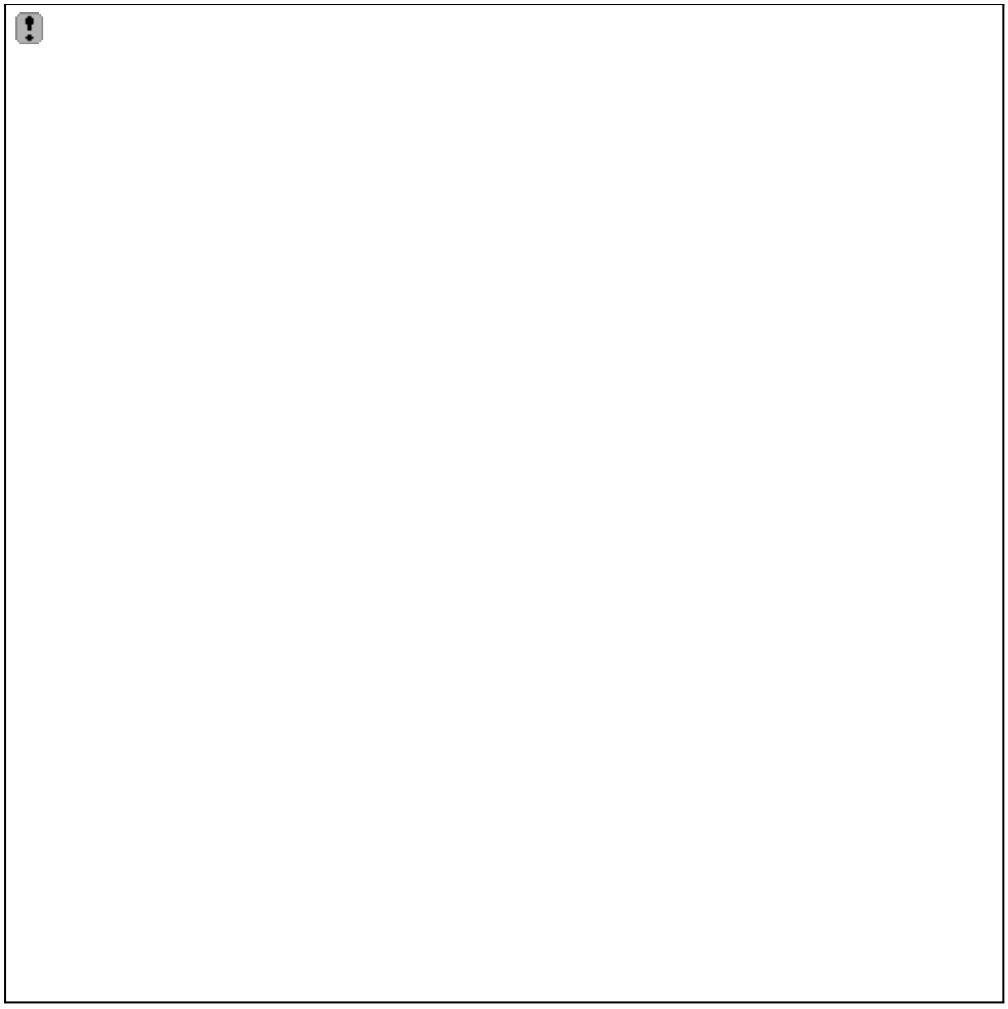

Figure 9.40: Sandstone infilling expanded cooling joints in andesite, Port Murray (NS 2087 0810). (Photo: G. Durant.)

Interpretation

The detailed evidence for the re-interpretation of the andesites as intrusions into largely wet and unconsolidated sandstone has been presented by Kokelaar (1982) (see the Port Schuchan to Dunure GCR site report). Geikie (1897) records 30 separate intrusions along the Turnberry section. It is not clear whether these are the result of 30 separate intrusions or whether there have been a smaller number of multiple sill-like intrusions at different depths within a pile of unconsolidated sediment. It is difficult to correlate individual sheets and hence to quantify the precise number of intrusive events, due to the compositional similarity between intrusions, the variability of character of the andesite within a single intrusion, the rapid changes in thickness of sheets and the presence of minor faulting. However, Tyrrell (1913) reported sufficient petrological variation to suggest that at least some of the andesite sheets were emplaced as separate events. If there were indeed 30 separate intrusions, then the local Lower Old Red Sandstone basin of sedimentation, presumably marked by a lake at the surface, must have been continuously sinking, possibly due to rifting associated with magmatic activity, in order to accumulate sufficient unconsolidated sediment into which subsequent sheets could be intruded.

As individual andesite sheets were intruded and cooled, a build-up of pressure beneath the intrusion would have caused the sediment to penetrate upwards into the cooling joints of the andesite as they opened. These joints are often curved and must have formed quite rapidly following intrusion. The upper parts of these sandstone ‘dykes' are rarely seen and hence the relationship between the sandstone in the ‘dykes' within an andesite sheet and that overlying the andesite intrusion cannot be fully evaluated. The fine-grained nature of the sediment and the local preservation of arthropod trackways (found by the author in Broad Sands Bay) argues for quiet depositional conditions.

Conclusions

Like the other GCR sites on the Ayrshire coast, this section is of national and international importance for the evidence demonstrating the high-level intrusion of magma into unlithified wet sediments. A sequence of 30 andesite ‘lavas' in this historically significant section has been re-interpreted as a series of shallow intrusions. The basal and upper parts of the andesite sills are well-exposed along the section between Turnberry Lighthouse and Port Murray, and evidence critical to the re-interpretation is present.

Reference list

Geikie, A. (1897) *The Ancient Volcanoes of Great Britain*, Macmillan, London.

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