

CULZEAN HARBOUR

G. Durant

OS Grid Reference: NS231102

Introduction

A down-faulted inlier of Lower Old Red Sandstone andesites crops out along the coast by Culzean Castle (Figure 9.34). The andesites represent a southerly extension of the Carrick Hills volcanic sequence, which is also exposed at Dunure (Port Schuchan to Dunure GCR site) and Turnberry (Turnberry Lighthouse to Port Murray GCR site). A general description of the overall sequence is given in the Port Schuchan to Dunure site description. These coastal outcrops have been studied for over 100 years (e.g. Smith, 1892) and the spectacular setting of Culzean Castle on top of a 35 m-thick andesite intrusion has been a source of inspiration to artists and geologists alike (Figure 9.36). Evidence from this section has been important in the re-interpretation of some of the lavas as sill-like intrusions into wet sediment (Kokelaar, 1982).

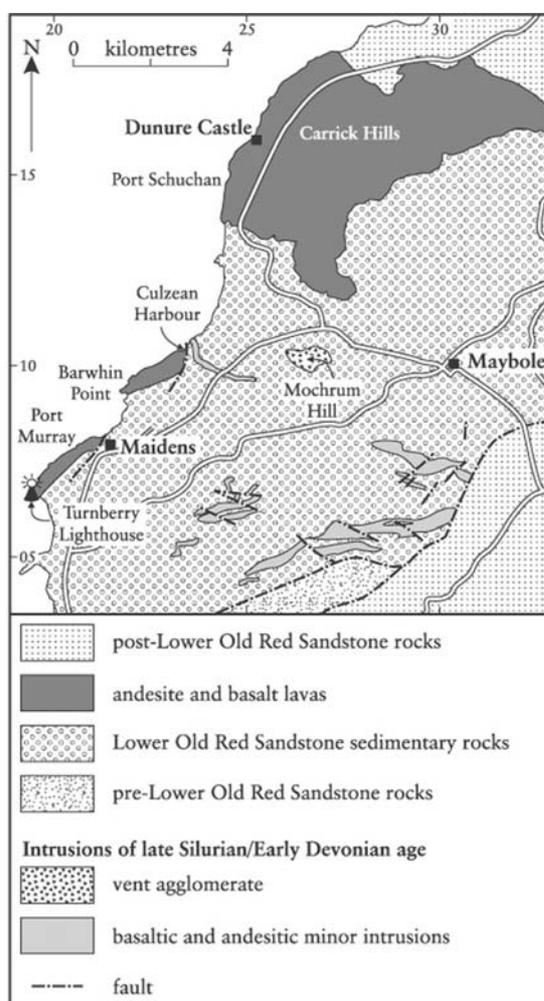


Figure 9.34: Map of the Ayrshire coast outcrops of Lower Old Red Sandstone volcanic rocks.

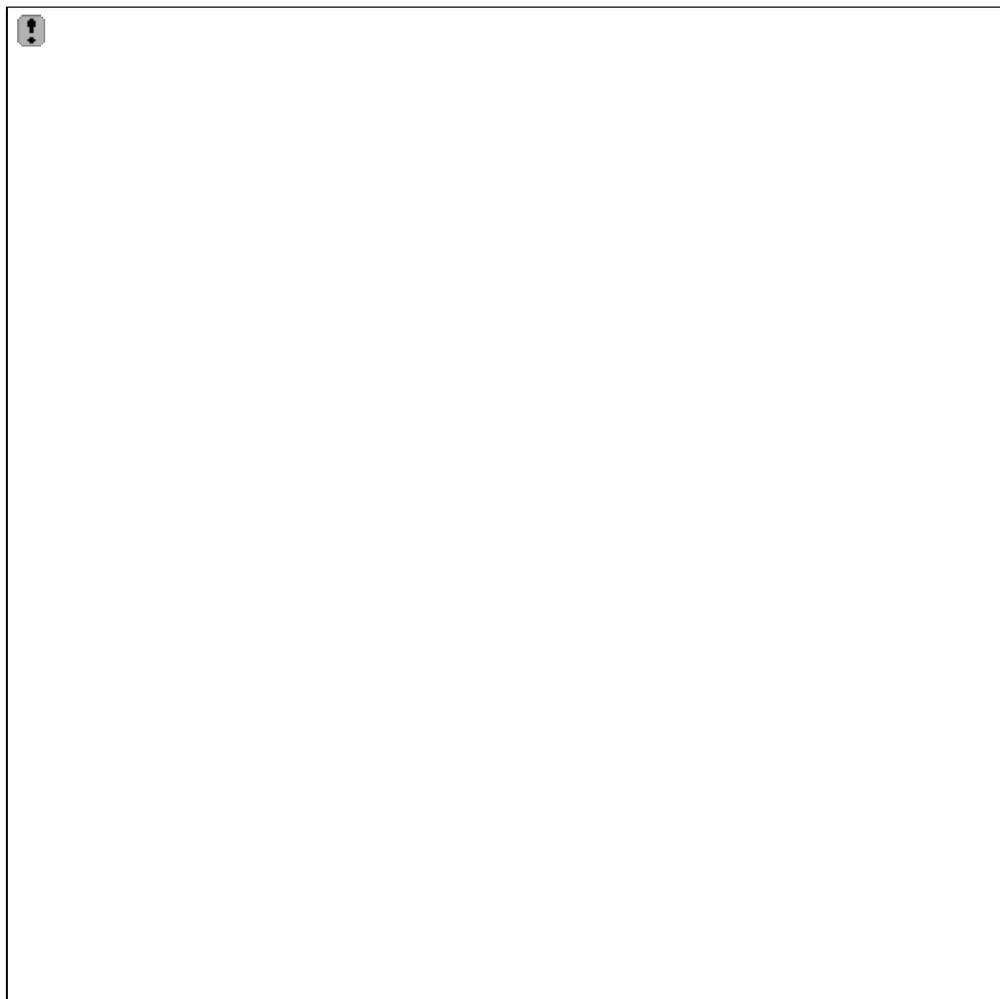


Figure 9.36: Culzean Castle from an old engraving by W. Daniell (c. 1838). Despite some vertical exaggeration, the spectacular setting of the castle on a cliff formed from a 35 m-thick sill of andesite is well conveyed.

Description

The base of the 35 m-thick andesite sheet which forms the main cliff beneath Culzean Castle is seen in the stack just to the north of the Culzean Harbour slipway (2311 1028). This enstatite andesite (Tyrrell, 1913) overlies a coarse debris flow deposit consisting of blocks of andesite and sandstone in a sandstone matrix (Figure 9.37, and see Kokelaar, 1982, fig. 4A). A highly vesicular basal pillowed zone cuts into the greenish grey laminated sandstone on top of the debris flow deposit. The laminations within the sandstone disappear close to the contact with the andesite and the sandstones are oxidized at the contact with andesite pillows (Kokelaar, 1982). The massive andesite is cut by numerous thin sandstone 'dykes' which can be traced back to a source in the sediment beneath the andesite. The pillowed top of the Culzean andesite intrusion contains pockets of structureless sandstone and is overlain by debris flow deposits similar to those beneath the sheet.



Figure 9.37: Pillowed base of an andesite sheet overlying volcanoclastic debris flow deposit at Culzean Harbour (NS 2311 1028). (Photo: G. Durant.)

The strongly pillowed base of a vesicular andesite forms the low cliff to the south of the Culzean Harbour slipway (2304 1022) just to the north of Dolphin House which sits on the raised beach. Individual pillows are up to 2 m across. Pale greyish-green fine-grained laminated sandstone occupies the space between the pillows. The bedding laminations in the sandstone are constant throughout the outcrop and they are consistent with the regional dip. A similar relationship is well displayed in the southern wall of a raised sea-arch close to the southern end of the GCR site (2271 1000), where the pillowed lobes at the base of another andesite sheet protrude into sandstone.

Amygdales and veins of agate and quartz within feldspar-phyric andesite are well displayed on the wave-polished surface immediately beneath the small roundhouse close to the southern end of Dolphin House (2299 1018). Vesicular andesites from this section have been described by Geikie (1897) as being some of the most beautiful volcanic rocks in Scotland. Larger, irregular masses of agate and quartz are seen within andesites a short distance to the south where a 1 m-long mass of agate, quartz and calcite, with quartz crystals lining a drusy cavity is exposed in the low cliff. A coarse breccia containing vesicular andesite fragments represents the particularly fragmented part of one andesite intrusion. The space between the andesite blocks is here filled by coarsely crystalline pink calcite rather than by fine-grained sandstone as elsewhere along the section.

Some compositional variation of the volcanic rocks is present in the area around Culzean Castle. The cliffs immediately beneath the castle are formed of enstatite andesite and an intrusive sheet of augite andesite with olivine occurs at Port Carrick, 1 km along the shore SW of Culzean (Tyrrell, 1913). To the north of Culzean olivine basalt forms a broad dyke which runs inland in the direction of the Mochrum Hill vent (Eyles *et al.*, 1929). At Barwhin Point, at

the SW end of the Culzean inlier, a breccio-conglomerate contains fragments of volcanic rock that are generally more siliceous than any others in the Ayrshire coast sequence.

Interpretation

A small number of andesite intrusions into fine-grained sediment are exposed in the cliffs along the coastal section around Culzean Castle. The many detailed features that result from such intrusions are described, interpreted and discussed in a historical context in the section on the Port Schuchan to Dunure GCR site. In the Culzean section, the typical pillowed bases of andesite intrusive sheets are particularly well-displayed. The laminations in the sandstone between the andesite pillows appear to be generally undisturbed by the intrusion of the andesite magma and all follow the regional dip suggesting relatively passive intrusion of the magma. The debris flow deposits exposed north of the slipway (Figure 9.37) suggest that extrusive andesites existed close by and that these had been re-worked, or that shallow intrusive rocks were subject to penecontemporaneous erosion (Kokelaar, 1982). The exact site of eruption of the andesite magmas is not known but the volcanic vent at Mochrum Hill, 3.5 km east of Culzean, may be a source of some of the magma (Eyles *et al.*, 1949). An earlier, more siliceous and more explosive phase of activity may be represented by clasts in the breccio-conglomerate at Barwhin Point.

Conclusions

Like the other sites on the Ayrshire coast, the Culzean Harbour site is of national and international importance for the evidence critical to the re-interpretation of the Lower Old Red Sandstone lavas as intrusive sheets that have burrowed into wet, unconsolidated sediment. The highly vesicular lower contact of a thick andesite sheet below Culzean Castle shows characteristic well-developed pillow structure and the sheet incorporates sediment-filled veinlets and inclusions of fine sandstone. Laminated sandstone within pillowed andesite is well-exposed in the low cliff to the SW. The situation of this section in the grounds of Culzean Castle makes for a memorable visit.

Reference list

- Eyles, V. A., Simpson, J. B. and MacGregor, A. G. (1929) The igneous geology of Central Ayrshire. *Transactions of the Geological Society of Glasgow*, **18**, 374–87.
- Eyles, V. A., Simpson, J. B. and MacGregor, A. G. (1949) Geology of Central Ayrshire. *Memoir of the Geological Survey of Great Britain*, Sheet 14 (Scotland).
- Geikie, A. (1897) *The Ancient Volcanoes of Great Britain*, Macmillan, London.
- Kokelaar, B. P. (1982) Fluidization of wet sediments during the emplacement and cooling of various igneous bodies. *Journal of the Geological Society of London*, **139**, 21–34.
- Smith, J. (1892) From the Doon to the Girvan Water, along the Carrick shore. *Transactions of the Geological Society of Glasgow*, **10**, 1–12.
- Tyrrell, G. W. (1913) A petrographical sketch of the Carrick Hills, Ayrshire. *Transactions of the Geological Society of Glasgow*, **15**, 64–83.