Mollinsburn Cuttings (A80), North Lanarkshire

[NS 716 718]

S.C. Loughlin

Introduction

The E–W-trending dyke-swarm associated with the Midland Valley Sill-complex contains tholeiitic basalt and quartz-dolerite dykes between 3 m and 75 m wide, discontinuous outcrops of which may be traced for up to 300 km. The Mollinsburn Cuttings GCR site on the A80 Glasgow to Stirling road reveals an excellent section through the Lenzie–Torphichen Dyke, a typical quartz-dolerite dyke that can be traced for over 40 km. It forms a conspicuous feature along much of its length and partially coincides with pre-existing E–W-trending faults.

The first Geological Survey map of this area (Sheet 31, Airdrie) was published in 1875. It was re-surveyed and re-published in 1924 and again in 1992 as Sheet 31W, the latter with an accompanying memoir (Forsyth *et al.,* 1996). Based on the field relationships exposed at this site and nearby, early workers suggested that the dykes of the E–W-trending swarm acted as feeders for the Midland Valley Sill-complex (Tyrrell, 1909b; Clough *et al.,* 1925). More recently, geochemical studies have confirmed that the dykes and sills are comagmatic (Macdonald *et al.,* 1981; Howard, 1999), and their emplacement mechanism has been discussed in great detail by Francis (1982). The Lenzie–Torphichen Dyke is one of a few in the Midland Valley that can be demonstrated to have acted as a 'fault riser', facilitating the transgression of sills between different strati-graphical levels (see also Wallstale GCR site report).

Description

The Lenzie–Torphichen Dyke, which is exposed intermittently from north of Bishopbriggs [NS 573 714] in the west to Cairnpapple Hill [NS 990 720] in the east, has an overall length of over 40 km and an average breadth of 40 m. The dyke is resistant to weathering in comparison to the host sedimentary rocks and therefore forms a distinctive topographical feature that is seen particularly well over a distance of 5 km, between Millersneuk, Lenzie [NS 665 718] and Mollinsburn [NS 720 717].

At Mollinsburn there are two parallel branches of the dyke that cut the Upper Limestone Formation (Figure 6.18). The northern branch is seen in road cuttings and as a gorse-covered ridge, Mollin Craig, to the west of the road, where horizontal columnar joints perpendicular to the dyke margins are conspicuous (Figure 6.19). The central part of the dyke is medium grained, becoming finer grained towards the chilled margins which are commonly glassy. In common with other quartz-dolerites of the Midland Valley Sill-complex and dykes, the central part contains feldspar laths (bytownite or labradorite mantled by oligoclase), ophitic to sub-ophitic pale-brown augite, and a mesostasis of micropegmatitic quartz and feldspar.

To the west of Mollinsburn, two offshoots of quartz-dolerite extend north-westwards from the main, northern dyke, one between the Lyoncross and Orchard limestones just west of Mollin Craig [NS 711 718] and one 2 km farther west [NS 695 717]. The dolerite was not encountered in workings below these outcrops, suggesting that they are portions of sills (Clough *et al.,* 1925). To the east of Mollinsburn, at North Medrox [NS 726 716], the dyke appears to be continuous with a sill on its south side, above the Calmy Limestone.

Evidence of the relationship between the intrusions and faulting is seen in other sectors of the Lenzie–Torphichen Dyke. Between Millersneuk [NS 665 718] and [NS 695 717], just to the west of the GCR site, the dyke coincides with a major E–W-trending fault (the Annathill Fault). There, dark mudstones, thin coals and sandstones of the Lower Coal Measures are tilted up vertically against the northern wall of the dyke, whereas horizontal beds of indurated sandstone of the Passage Formation abut the southern margin. The dyke has been altered to 'white trap' up to 3 m inwards from both contacts. Some 25 km farther to the east, in the Torphichen district around [NS 970 720], the dyke is also emplaced

along fault planes. The main sill in this area occurs in the Upper Limestone Formation on the north side of the fault but the only sill to the south of the fault occurs at much higher stratigraphical levels, in the Lower Coal Measures. Unfortunately the sill outcrops in that area are several kilometres apart so that the exact location and nature of the transgression cannot be determined.

Interpretation

The Late Carboniferous dyke-swarm of southern Scotland was emplaced partially along recently formed E–W-trending fractures. The petrological and geochemical similarities between the dykes and the Midland Valley Sill-complex were recognized long ago and have been confirmed recently by more detailed studies (see 'Introduction' to this chapter).

In the Kilsyth–Croy district, about 5 km north of Mollinsburn, east-west dykes are intimately associated with a lens-shaped body of quartz-dolerite termed a 'laccolite' by Tyrrell (1909b) (meaning that it was fed by vertical dykes and has slightly transgressive upper and lower contacts). He recognized from field evidence and mine plans that two dykes terminate in the intrusion. The 'laccolite' is thickest between the two dykes and thins away rapidly to the north and south, i.e. at right angles to the dykes. In addition, Tyrrell compiled isopachs (lines joining parts of the intrusion of equal thickness) and found that it is an ellipsoid elongated east–west, parallel to the dykes. Based on this evidence he suggested that the dykes were feeders to the intrusion. Evidence that the Lenzie–Torphichen Dyke is also a feeder to the sill-complex was revealed by Clough *et al.* (1925) when they described one of the offshoots of quartz-dolerite in the Mollinsburn district.

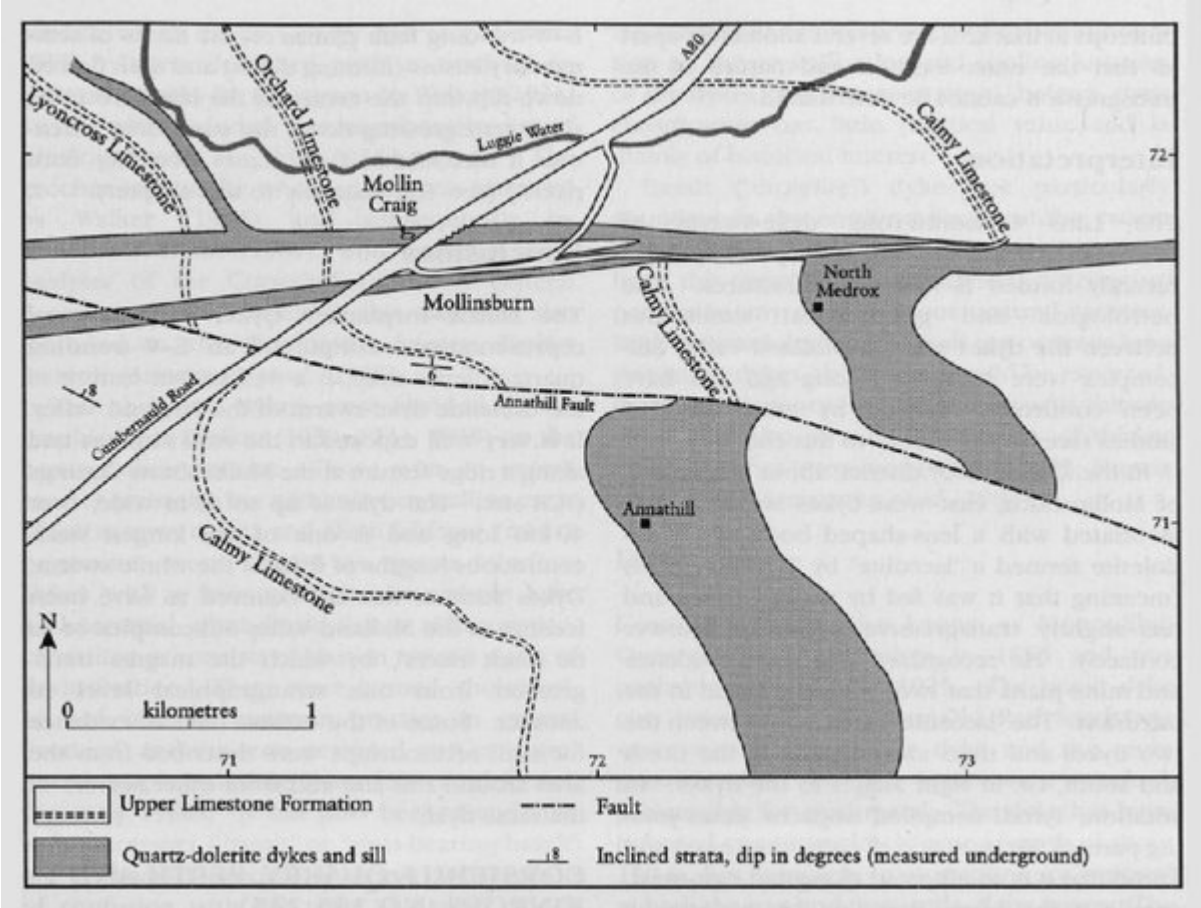
Peach *et al.* (1910) were the first to recognize the transgression of the sill-complex in the Torphichen district. In this area the Lenzie–Torphichen Dyke was described as a 'fault riser', meaning that emplacement was along a preexisting fault plane. This provided a means for the sill-complex to transgress to different stratigraphical levels on either side of the fault along which it is emplaced. Similar relationships were interpreted by Clough *et al.* (1925) around Mollinsburn, and particularly good examples of transgression were described subsequently from the Stirling district (Dinham and Haldane, 1932; Francis *et al.,* 1970; see Wallstale GCR site report).

Early observations, such as these, all contributed to the overall model for the emplacement of the tholeiitic intrusions proposed by Francis (1982). In this model, magma rose along E–W-trending fault planes on the flanks of sedimentary basins (forming dykes) and then flowed down-dip into the centre of the basin (forming sills), transgressing down the succession whenever it met further fault planes (forming 'fault risers') (see 'Introduction' to this chapter).

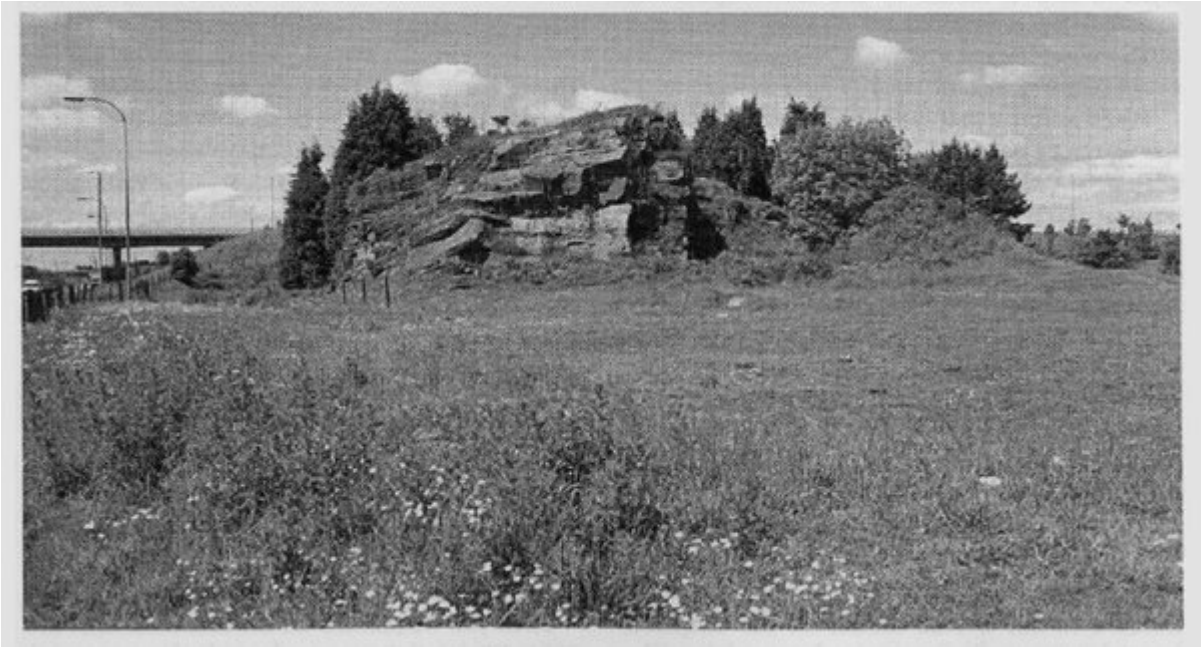
Conclusions

The Lenzie–Torphichen Dyke, a typical and representative example of an E–W-trending quartz-dolerite dyke, is a well-known feature of the tholeiitic dyke-swarm of the Midland Valley. It is very well exposed in the road cuttings and along a ridge feature at the Mollinsburn Cuttings GCR site. The dyke is up to 40 m wide, over 40 km long and is one of the longest near-continuous lengths of dyke in the whole swarm. Dykes such as this are believed to have been feeders to the Midland Valley Sill-complex or to be 'fault risers', by which the magma transgressed from one stratigraphical level to another. Some of the earliest lines of evidence for such relationships were described from the area around this site and from other sectors of the same dyke.

References



(Figure 6.18) Map of the area around the Mollinsburn Cuttings GCR site. Based on British Geological Survey 1:10 000 Sheet NS 77 SW (1987).



(Figure 6.19) E–W-trending quartz-dolerite dyke exhibiting good horizontal columnar jointing at Mollin Craig, Mollinsburn Cuttings GCR site. (Photo: C. MacFadyen.)