Langbaurgh Ridge and Cliff Ridge

Highlights

The dyke is the most laterally extensive and best exposed member of the Tertiary swarm of northeast England. It shows remarkable chemical uniformity and is compositionally identical with rocks in Mull. Calculations suggest that it was emplaced by rapid lateral flow over a period of as little as 1–5 days, from a source beneath Mull.

Introduction

The Tertiary Cleveland Dyke cuts and indurates Jurassic sediments in the Langbaurgh and Cliff Ridges close to the village of Great Ayton, on the border of Cleveland and North Yorkshire (Figure 7.6). The basaltic dyke is a member of the Mull dyke swarm, the site is about 370 km from the focus of the swarm in the Mull centre (see Chapter 5).

Early descriptions of the dyke include those of Tate and Blake (1876) and Barrow (1888) who also described the petrography. Petrographic descriptions were also given by Teall (1884, who cited an analysis by Stock) and by Holmes and Harwood (1929). Numerous chemical analyses were made by Hornung *et al.* (1966). MacDonald *et al.* (1988) have modelled emplacement of the dyke.

Description

The Cleveland Dyke is the southernmost member of a swarm of east–west to WNW–ESE-trending tholeiite (quartz dolerite) dykes in north-east England which focus on the Mull Tertiary central complex (Figure 1.1). It is the most laterally extensive and best-exposed member of this swarm. The dyke consists of a fine-grained, porphyritic basaltic andesite which has up to 13% normative quartz. Phenocrysts of plagioclase are conspicuous in hand specimen as are small rounded vesicles up to 10 mm diameter. The plagioclase phenocrysts, which may be aggregated, are generally of labradorite ($An_{50–60}$) or, rarely, of anorthite (An_{90}) composition. They are accompanied by microphenocrysts of pigeonite which sometimes mantle hypersthene cores. The groundmass plagioclase, augite and opaque oxides may enclose areas of quartz and alkali feldspar or, in the chilled margins, there may be intersertal areas of clear brown glass. Cognate basaltic inclusions up to 5 mm in diameter and derived from the margins are common. The vesicles contain quartz, calcite, chlorite and clay minerals (which may expand on exposure to the atmosphere causing disintegration of the vesicles' contents), rare epidote, pyrite, pectolite and mesolite (cf. Barrow, 1888). The basalt at the contacts with highly fossiliferous Middle Lias sandstones and ironstones is distinctly finer grained than the centre of the dyke, but tachylitic rock is not found. Subhorizontal, columnar jointing is developed in the marginal dolerite and has given rise to good examples of spheroidal weathering.

The dyke is up to 25 m in width and appears to have produced little alteration of the sediments apart from discoloration and induration for a distance of about 2 m from the contact. Its course across country is readily observed since its *en échelon* segments form elongate, low ridges; the effect is well seen when Langbaurgh Ridge is viewed from Cliff Ridge (Locality 3, (Figure 7.6)a). Since the majority of the rocks of North Yorkshire and Cleveland are soft and crumbling, the dyke has been extensively quarried and even mined (as under Langbaurgh Quarry) for setts and aggregate; hence, both parts of this site and many other 'outcrops' resemble railway cuttings. In the disused Langbaurgh Quarry five segments of the north wall of the dyke have been preserved. In the upper Cliff Rigg Quarry a cross-section of the dyke occurs at the extreme east end (4), where the dyke may become 'headed'. A contact of baked sediments against marginal dyke occurs 100 m into the site from its west end (2) and on the same side a longitudinal section of the dyke is preserved near the west end (1).

Interpretation

The dyke was the subject of early attempts to date rocks using radiometric techniques when Dubey and Holmes (1929) demonstrated that it was younger than the (Stephanian) Whin dolerites of north-east England. Subsequently, the Palaeocene age of the Cleveland Dyke was confirmed when a date of c 58 Ma was obtained by the K–Ar method (Evans *et al.,* 1973) and by its magnetic properties (for example, Dagley, 1969).

It is demonstrably post Jurassic and the clear connection with the Mull central complex also supports a Palaeocene age.

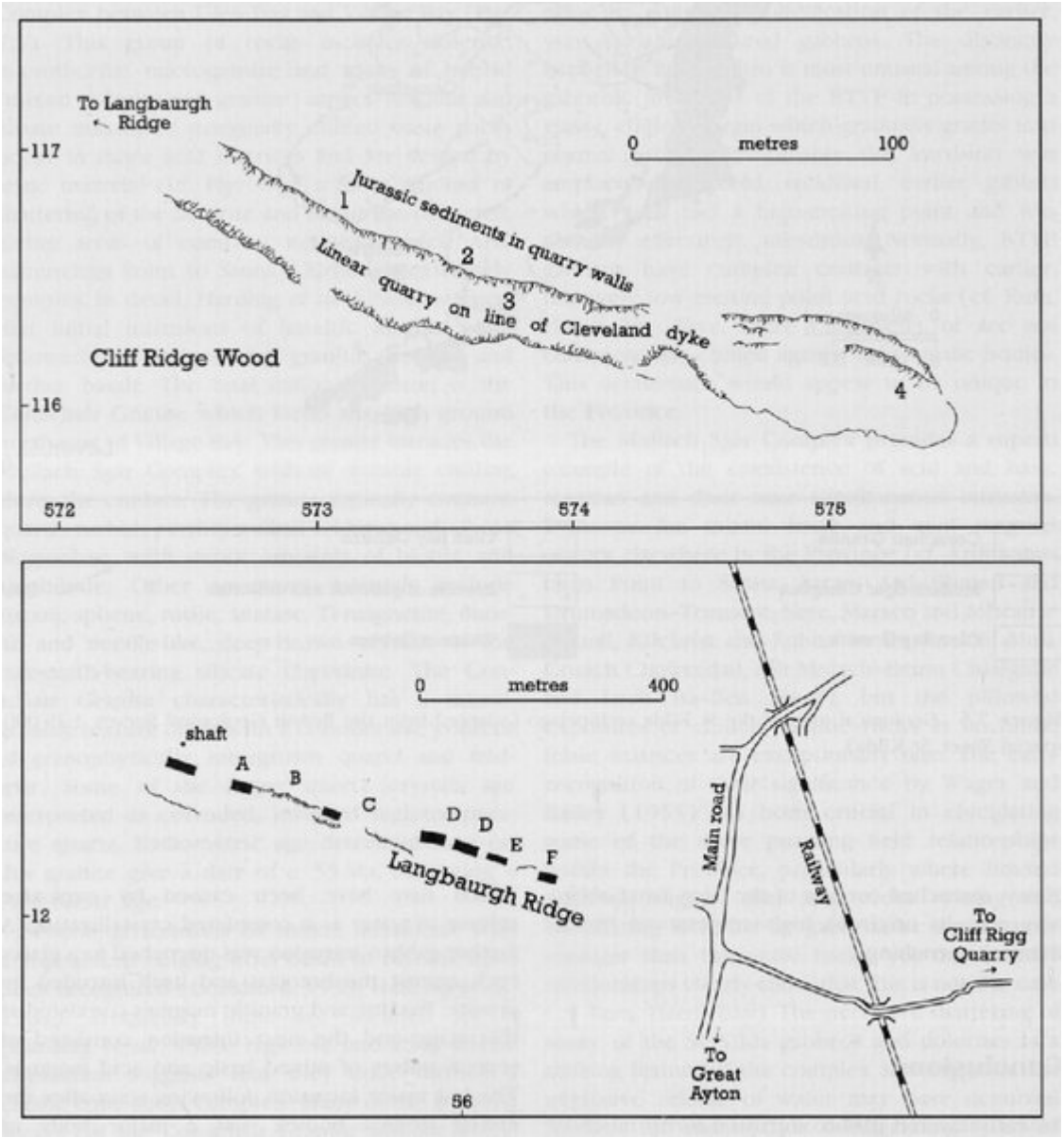
There has been debate whether the dyke was actually fed from a source in Mull, or rose vertically from subjacent mantle along a fracture system propagated from Mull. The considerable distance from Mull (*c.* 370 km) and the absence of any systematic increase in thermal metamorphism around the dyke when traced towards Mull have perhaps supported the suggestion that the magma rose vertically, but this does require a laterally extensive magma source beneath the dyke over its entire extent, for which there is little evidence (MacDonald *et al.,* 1988). MacDonald *et al,* have made a detailed examination of the petrology of the dyke which substantiates the earlier claims that it is extremely similar compositionally to some of the Mull non-por-phyritic central magma-type intrusions. They have also carried out numerical modelling of the flow of magma through a dyke of this size from which they conclude that the dyke could have been fed by lateral flow from a large magma chamber beneath Mull, and that its emplacement could have taken place in the very short time of 1–5 days.

Conclusions

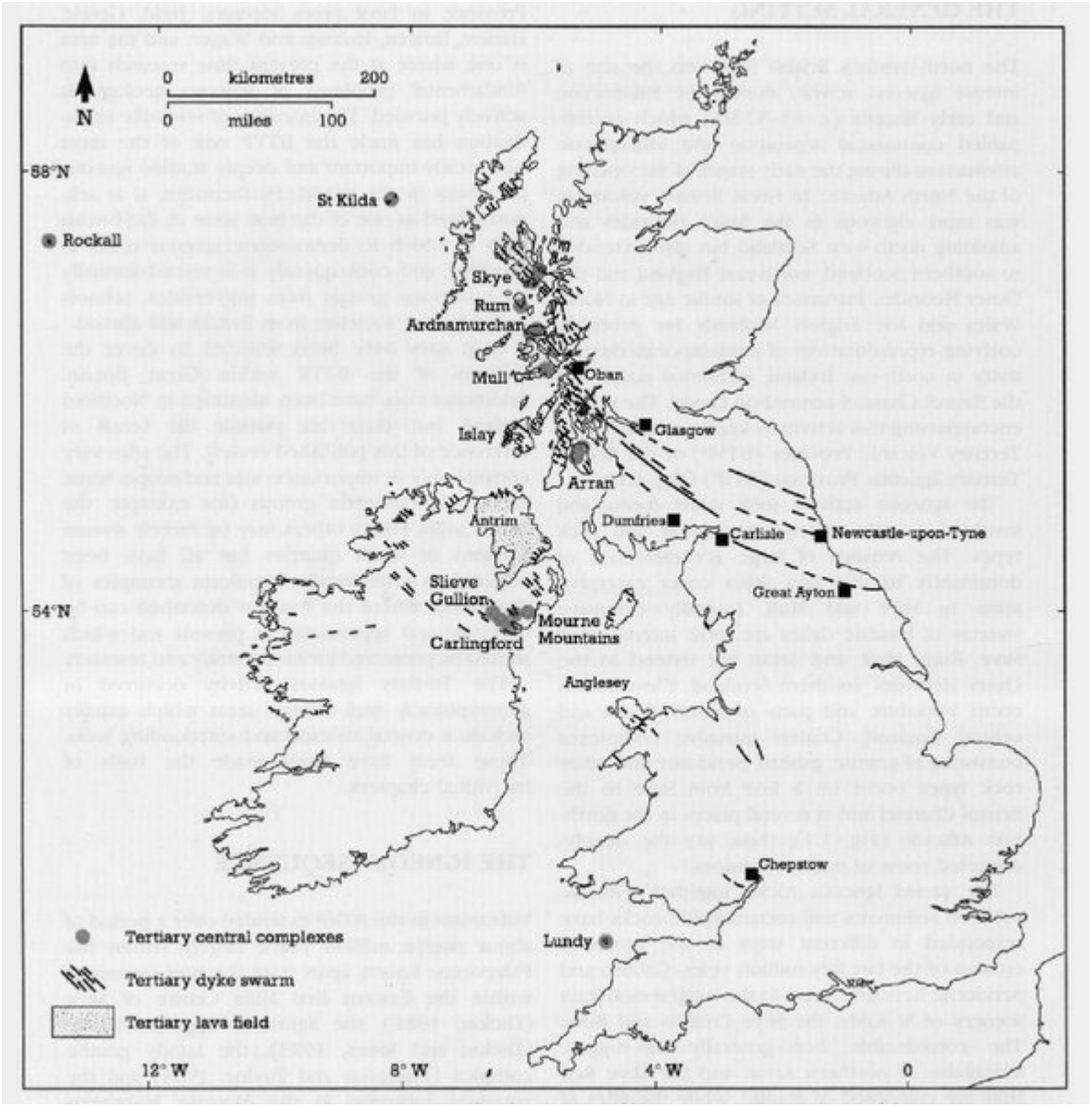
The Cleveland Dyke is a compositionally uniform quartz dolerite which closely resembles basaltic and doleritic rocks in the Mull central complex. It is a compact, fine-grained rock with scattered, small, plagioclase crystals and small vesicles. As it is the only durable rock in North Yorkshire and Teeside it has been extensively quarried and mined for aggregate.

Recent research has shown that the dyke was probably intruded laterally from a source beneath the Isle of Mull in western Scotland, and that lateral emplacement may have taken place in a few days.

References



(Figure 7.6) Sketch maps showing outcrops of the Cleveland Dyke near Great Ayton, North Yorkshire: (lower) Langbaurgh Ridge. Localities A—F refer to points where the north margin of the dyke has been preserved. (upper) Upper part of Cliff Rigg Quarry. For explanation of localities 1–4 see text.



(Figure 1.1) Map of the British Isles, showing the distribution of Tertiary central complexes, dyke swarms and lavas (submarine occurrences not shown). Modified from Emeleus, in Sutherland (1982, figure 29.1).