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# Clee Hill Quarries, Shropshire

[SO 595 760]

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## Introduction

The Clee Hill Quarries GCR site in Shropshire provides excellent exposures of an alkaline, olivine-dolerite sill intruded into Coal Measures strata at the Langsettian (Westphalian A)–Duckmantian (Westphalian B) boundary. The sill is variously termed the 'Clee Hills Sill' or the 'Titterstone Clee Sill'. The outcrops on Clee Hill and Titterstone Clee Hill are two of several outliers, representing remnants of a formerly extensive sheet; there are other outliers in the Brown Clee Hills. The Clee Hill Quarries GCR site is important in demonstrating the intrusive nature of the sill and its relationship with the Coal Measures strata that it intrudes. It also exhibits Pleistocene red weathering of the dolerite.

The sill is exposed in a complex of two quarries extending over an area of 1 km<sup>2</sup>, Dhustone Quarry [SO 593 765] in the north-west and Incline Quarry [SO 596 757] in the south (Figure 7.12). A third quarry, Belfry Quarry [SO 598 765], is now back-filled with Coal Measures waste. Current workings for hard rock aggregate are in Dhustone Quarry in an area formerly covered by over 30 m of Coal Measures, the workings extending eastwards almost to Belfry Quarry. The outlier on Titterstone Clee Hill to the north was formerly worked extensively.

Field relationships indicate merely that the sill is Westphalian or later in age; it had been suggested that it may even be Tertiary until Urry and Holmes (1941) used it as a subject for early attempts at Pb-He dating and calculated an age of 135 Ma (see also Dubh Loch GCR site report). Subsequently Fitch and Miller (1964) determined a K-Ar whole-rock age of 295 ± 5 Ma (c. 301 Ma with new constants). Descriptions of the quarries were given by Pocock (1931), Marshall (1942), Toghill (1990), Turner and Spinner (1990) and Crump and Donnelly (1994).

## Description

The Clee Hill Quarries GCR site lies in the axial area of a NE-trending syncline occupied partly by Coal Measures strata (Dixon, 1917). The Coal Measures overlie a thin succession of unconformity-bound units, the Namurian Cornbrook Sandstone and the Dinantian Carboniferous Limestone. The sill intrudes the Coal Measures in the quarries and steps down to progressively lower levels to rest on Upper Old Red Sandstone on Titterstone Clee Hill. It is about 60 m thick, displays good columnar jointing locally and has a conchoidal fracture. Fitch and Miller (1964) noted that two sills are present, indicating multiple intrusion. Lateral offshoots of the sill into the Coal Measures, and the presence of chilled margins confirm an intrusive origin and the contact of the sill with the overlying Coal Measures is well displayed at Incline Quarry (Figure 7.13). Crump and Donnelly (1994) noted that where the sill is unprotected by a cover of Coal Measures, it is deeply weathered to an orange-red regolith, probably the product of weathering during the warm, humid interglacial periods of the Pleistocene Epoch. A diamicton that overlies the solid rocks of Clee Hill has been interpreted variously as a solifluction/gelifluction deposit (Hains and Horton, 1969) and a glacial (?Anglian) till (Crump and Donnelly, 1994).

The rock is a very hard, fine-grained olivine-dolerite, typically dark blue-grey where fresh but weathering to greenish-grey. Based on descriptions by Urry and Holmes (1941), Sabine (unpublished Geological Survey report, 1953) and Crump and Donnelly (1994), the rock consists of olivine phenocrysts set in a ground-mass of plagioclase laths (bytownite-labradorite with some zoning to oligoclase) and augite, with minor magnetite, pigeonite, apatite and ruffe. Analcime occurs interstitially. Olivine shows complete to partial serpentization and some plagioclase is albitized and replaced by carbonate. A major element oxide analysis of the sill was given by Kirton (1984), who noted that the sill is nepheline-normative. Fitch and Miller (1964) dated a fresh analcime-bearing olivine-dolerite, with only slight zeolitization and minor serpentization, from the lower of two sills on Titterstone Clee Hill.

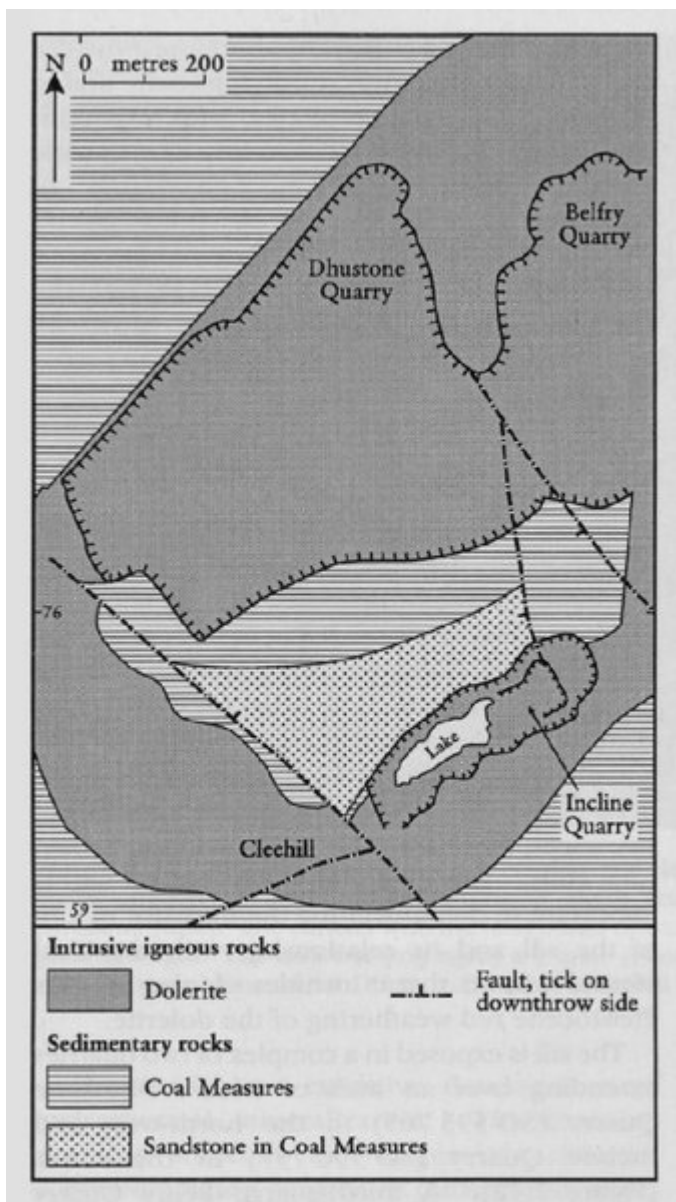
## Interpretation

Early workers (Lapworth *et al.*, 1898; Watts, 1904) interpreted the dolerite as intrusive but it was later interpreted as extrusive by Pocock (1931). Pocock's conclusion was challenged by Marshall (1942), who presented convincing evidence, now universally accepted, of the intrusive nature of the sheet. This was supported by E.B. Bailey (in discussion of Marshall, 1942), who suggested that the sill was intruded into waterlogged Coal Measures sediment, a suggestion later repeated by Francis (1970a) and Kirton (1984). Turner and Spinner (1990) provided confirmation of the intrusive nature of the dolerite, with the observation that spores in the Coal Measures overlying the sill are thermally blackened. The spores date the Coal Measures enclosing the sill as spanning the Langsettian (Westphalian A)–Duckmantian (Westphalian B) boundary, with the strata below the sill correlated with the Ra miospore biozone (equivalent to a Langsettian age) and those above with the NJ biozone (equivalent to a Duckmantian age). Given the Bolsovian (Westphalian C) age of the volcanic rocks of the West Midlands suite (see Barrow Hill GCR site report), the K-Ar whole-rock age of c. 301 Ma determined by Fitch and Miller (1964) is probably a minimum age, as suggested by Kirton (1984), and not the age of intrusion.

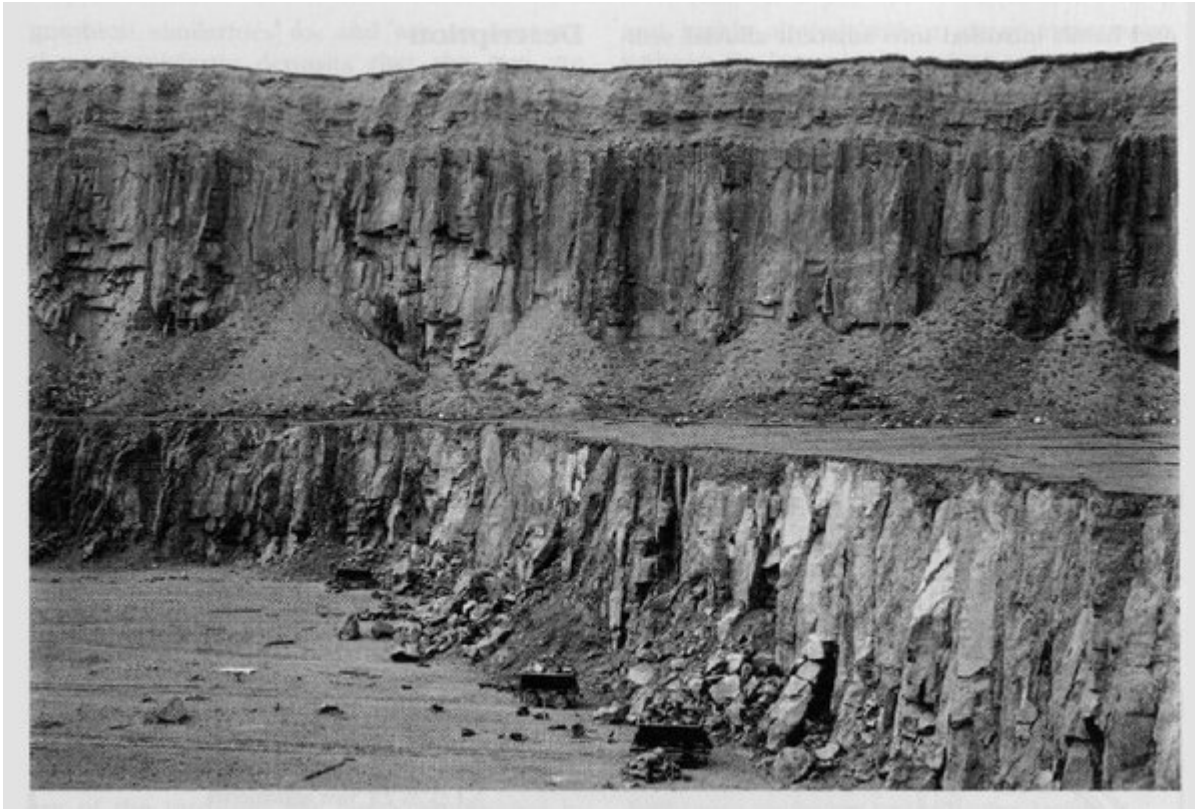
## **Conclusions**

The Clee Hill Quarries GCR site provides extensive exposures of a fresh, Westphalian alkaline igneous intrusion and constitute a type locality for the West Midlands suite of sills. The sill appears to consist of more than one intrusion, and columnar jointing is well displayed in parts of the site. The intrusive relationship with the containing Coal Measures strata of Langsettian to Duckmantian (Westphalian A to B) age is demonstrable, with Coal Measures overlying the sill at Incline Quarry. As a result of temperate weathering in Pleistocene times, the sill is deeply weathered locally, with an overlying red-brown, ferruginous clay soil. The site also has historical importance as the sill was the subject of one of the earliest attempts at radiometric dating.

## **[References](#)**



(Figure 7.12) Map of the Cleve Hill Quarries GCR Site. Based on British Geological Survey 1:10 000 mapping by W. Barclay (1997).



*(Figure 7.13) Columnar-jointed dolerite in a quarry at Clee Hills (probably Incline Quarry), taken in 1933. The section is about 25 m high, including about 6 m of baked mudstones and sandstones of the Coal Measures overlying the sill. (Photo: British Geological Survey, No. A6226, reproduced with the permission of the Director, British Geological Survey, © NERC.)*