Chapter 3 Nuneaton Inlier

Introduction

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The Precambrian outcrop at Nuneaton is limited to a 2.8 km^2 area, but quarrying has revealed a number of impressively large sections that allow a comprehensive range of lithologies and structures to be viewed. To take advantage of this, and of current local conservation initiatives, two sites are described, the existing GCR site in Boon's Quarry and a new site at nearby Judkins' Quarry (Figure 3.1). Taken together, these sites show that the larger part of the Precambrian succession consists of bedded volcaniclastic rocks collectively known as the Caldecote Volcanic Formation. They also demonstrate a complex late Precambrian history, involving faulting, flexuring and two phases of igneous intrusion, which took place before deposition of the overlying and unconformable Lower Cambrian strata. The Caldecote Volcanic Formation and associated intrusions can be compared geochemically, if not always lithologically, with the Precambrian rocks of Charnwood Forest, some 23 km farther to the north-east (Carney and Pharaoh, 1993; Bridge *et at,* 1998), as discussed in the introduction to Chapter 2. It follows that the two Precambrian sequences are correlatives, and together form a major basement domain known as the 'Charnwood Terrane' (Chapter 1).

Lapworth (1882) first demonstrated the antiquity of the Caldecote Volcanic Formation, by his discovery of Cambrian fossils in the strata lying unconformably above. However, their Precambrian age was not finally confirmed until Lapworth (1898) established the magnitude of the unconformity, from the fact that the highest beds in the overlying Hartshill Sandstone Formation contain Lower Cambrian fossils. The exposures of this unconformable contact, which is particularly accessible at Boon's Quarry, underline the importance of the Nuneaton Inlier. This is one of the few localities in southern Britain with rocks that demonstrate the passage between the Proterozoic and Lower Palaeozoic erathems.

The early work of Lapworth (1886, 1898) recognized the diversity of lithologies in the then 'Caldecote Volcanic Series'. Subsequent studies involved petrographical and chemical investigations into a body of granophyric diorite at Judkins' Quarry, which represents the final phase of Precambrian magmatism. The classification of this intrusion as 'markfieldite' by Jones (1935) was in recognition of its similarity to the eponymous intrusive rocks in the south of Charnwood Forest (Chapter 2). At the time, this correlation was highly significant to the Precambrian stratigraphy of the English Midlands because the quarry exposures clearly demonstrate that the granophyric diorite is overlain unconformably by Lower Cambrian strata (Wills and Shotton, 1934). Hence the Charnwood Forest markfieldite, and the strata into which it was emplaced, must also be Precambrian. The studies by Allen (1957, 1968a) were the most modern treatments of the stratiform Caldecote Formation sequences and their interpretation, until the work carried out by Carney and Pharaoh (1993), Carney (1995) and Bridge *et al.* (1998).

Although the Nuneaton Precambrian rocks were affected by late Precambrian folding and faulting, and are also well jointed, they do not show the penetrative cleavage affecting the equivalent rocks in the Charnwood Forest outcrop. There is nevertheless a minor metamorphic discordance between the Caldecote Volcanic Formation, which is at lower anchizonal metamorphic grades, and Lower Cambrian mudstones that record only the late diagenetic grade (Merriman *et al.,* 1993).

Caldecote Volcanic Formation

This formation encompasses all Precambrian rocks of volcaniclastic type at Nuneaton and was given its present name by Brasier *et al.* (1978) as part of a review of lithostratigraphical terminology for the overlying and unconformable Hartshill Sandstone Formation. Its type area is considered to be the whole of the Precambrian outcrop shown in (Figure 3.1), and the type section (Bridge *et al.,* 1998) has been chosen as the Boon's Quarry GCR site. The formation is estimated to be at least 130 m thick beneath the unconformable Lower Cambrian and Triassic strata and its base is neither seen nor has been encountered in boreholes.

The Caldecote Formation is informally subdivided (Bridge *et al.,* 1998) into two principal components; a crystal-lapilli tuff facies grouping, which is predominant, and a bedded to laminated, tuffaceous siltstone facies grouping. The finer-grained lithologies constituting the latter grouping were originally thought to represent a lower bedded succession (Allen, 1968a), but the present, particularly deep, quarry sections demonstrate that in fact they are interspersed at various stratigraphical levels within the crystal-lapilli tuffs. The sequence in the quarries has a remarkably high content of pyroclastic material and so may be the approximate equivalent of the Maplewell Group in Charnwood Forest (Chapter 2).

Geochemical studies summarized by Carney and Pharaoh (1993) and Bridge *et al.* (1998) concluded that the Caldecote Volcanic Formation represents volcaniclastic sediments containing detritus derived from similar magmatic sources to those supplying the Charnian Supergroup farther north. A volcanic arc founded upon oceanic or attenuated continental crust is therefore the most likely environment in which these rocks could have formed (Chapter 2, Introduction). Sedimentary structures such as normal grading and soft sediment deformation suggest subaqueous deposition of the Caldecote Volcanic Formation, as is the case for the Charnian Supergroup. Unique features of the Caldecote Volcanic Formation, however, are the predominance, and great thickness, of coarse-grained and lithologically homogeneous beds representing the crystal-lapilli tuff facies grouping, which has no precise parallel in Charnwood Forest. As discussed later, such rocks may belong to a category of crystal-enriched subaqueous pyroclastic flow that is becoming increasingly documented in young volcanic arc systems.

The age of the Caldecote Formation is no younger than 603 ± 2 Ma, which is the value obtained radiometrically by the U-Pb zircon method on the granophyric diorite intrusion at Judkins' Quarry (Tucker and Pharaoh, 1991). This limiting age for the Caldecote Formation has also been applied to the Charnian Supergroup, on the basis of geochemical similarities, discussed above, between the Nuneaton granophyric diorite and the markfieldite intrusion (South Charnwood Diorites) of Charnwood Forest. Such a correlation presents problems, however, since the Charnian Supergroup contains Ediacaran fossils (Chapter 8), the presence of which in other parts of the world would indicate an age no older than 580 Ma (see discussion in McIlroy *et al.,* 1998, and Chapter 2).

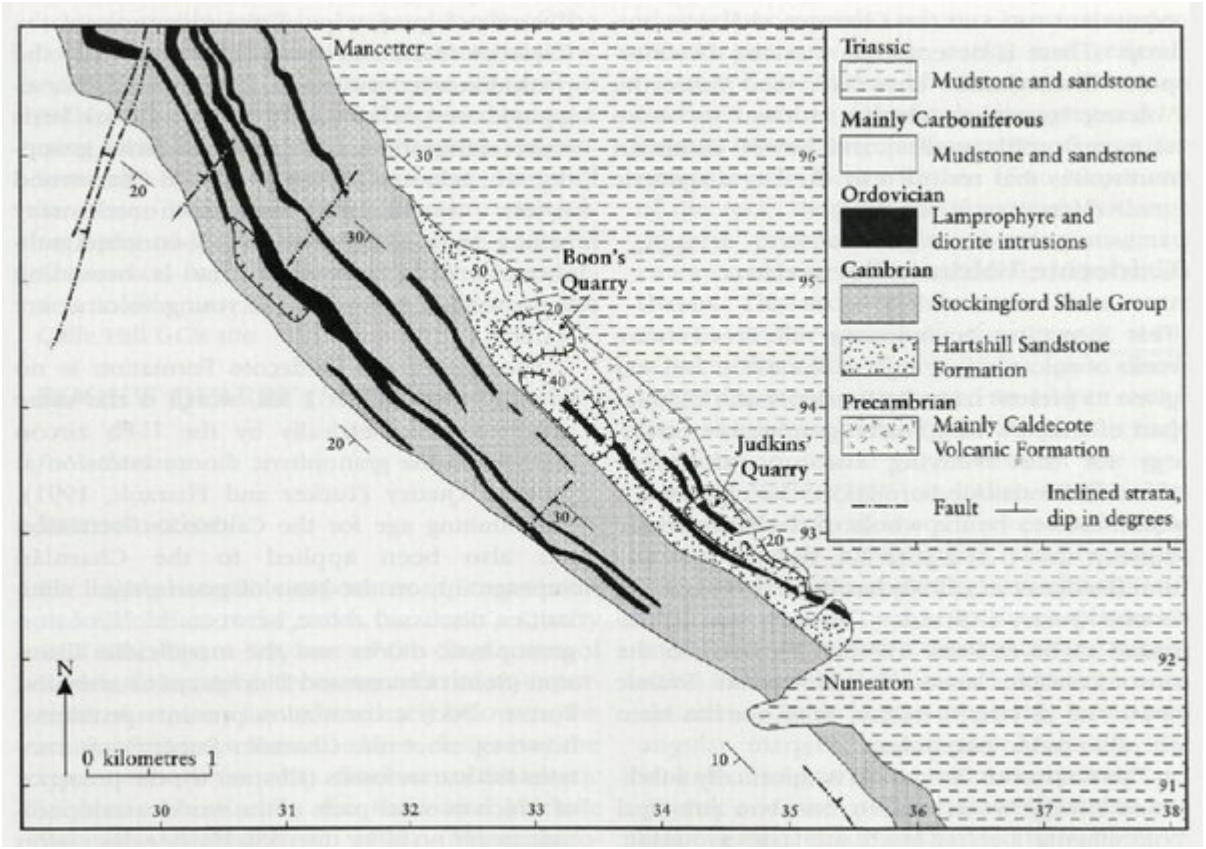
Precambrian intrusive rocks

Intermediate to basic intrusions are an important feature of the Nuneaton Precambrian assemblage, and occupy an estimated 25 per cent by volume of the total Precambrian exposure at the large Judkins' Quarry GCR site. Two separate intrusive phases are demonstrated by cross-cutting relationships seen here; they comprise an early complex of porphyritic to sparsely-phyric basaltic-andesite and microdiorite intrusions, and a younger intrusive stock of granophyric diorite (or markfieldite).

The basaltic-andesite and microdiorite intrusions were collectively termed the 'Blue Hole Intrusive Series' by Allen (1957), but such a rank is inappropriate for these rocks, which are here referred to informally on the basis of lithological type. These intrusions are chemically identical to the coarser-grained 'North Charnwood Diorites' of Charnwood Forest (Bridge *et al.,* 1998). Their Precambrian age is demonstrated, uniquely in the Midlands region, at the Boon's Quarry GCR site, which shows that a dyke of basaltic-andesite, emplaced into crystal-lapilli tuff, becomes reddened in its upper part and is unconformably overlain by basal beds of the Lower Cambrian Hartshill Sandstone Formation.

The intrusion of granophyric diorite in Judkins' Quarry has been well exposed by quarrying, which shows it to be overlain unconformably by the Lower Cambrian Hartshill Sandstone Formation. The chemistry and petrography of the equivalents of these rocks in Charnwood Forest is discussed in the introduction to Chapter 2, and in the section on the Cliffe Hill GCR site.

References



(Figure 3.1) Outline geological map of part of the Nuneaton Inlier, showing the location of the GCR sites (in bold lettering).