B15 Brent Tor

[SX 471 804]

Highlights

This locality shows a unique example of an early Carboniferous basaltic pillow lava and hyaloclastite seamount, or mound, with a reworked volcaniclastic apron.

Introduction

This site covers the conical knoll of Brent Tor capped by its historic chapel (Figure 4.39). It is composed of early Carboniferous volcanics within the flysch-dominated Blackdown tectonic unit (Isaac, 1981) or Heathfield Nappe (Isaac *et al.,* 1982) and forms an isolated klippen occupying the high ground above the Greystone Nappe below. In the scheme of Selwood and Thomas (1986a) it is part of the Blackdown Nappe. The Brent Tor volcanics are generally recognized as being early Carboniferous as they rest on cherts and slates assigned to this age. However, Selwood (1974) suggested that the volcanics and associated radiolarian-bearing black slates might be late Devonian, because the sediments are lithologically similar to strata of this age north of Tavistock. The problem is compounded by the structural complexity; much of the area is composed of thin thrust slices of both Upper Devonian and Lower Carboniferous strata.

The detailed petrography of the volcanic rocks of the region to the west of Dartmoor has been described by Reid *et al.* (1911), as well as the mineralogical effects of contact metamorphism by the granite. The rocks of Brent Tor, which are outside the granite aureole, have long been recognized as the products of a volcanic eruption and, together with other magmatic rocks in the immediate vicinity, were annotated and examined in thin-section by Rutley (1878). This work was one of the first to figure hand-painted thin-section drawings of magmatic rocks from south-west England by the Geological Survey. Little modern work has been done on this interesting volcanic edifice, although a few of our unpublished chemical analyses indicate that the lavas are alkali basalts, in common with many of the extrusives and intrusives found to the west of Dartmoor.

Description

The Brent Tor volcanics are mainly composed of coarsely bedded volcaniclastics that have a southerly dip. Near the base of the section are variably foliated, platy, light and dark-grey fine tuffs upon which rest a series of basaltic hyaloclastites and pillow-lava breccias that comprise the main outcrop. The grain size of the hyaloclastites and the distribution of pillow fragments varies considerably. The crags directly below the chapel near the main path are composed of small, elongate, dark basaltic fragments set in a greyish-green, speckled tuffaceous matrix. Occasionally, larger (0.1–0.2 m), often highly vesicular, broken fragments of pillow lava with curved surfaces and chilled margins may be present. Near the chapel and towards the top of the volcanic sequence are numerous small, red (highly oxidized), scoriace-ous lava fragments set in a hyaloclastite matrix. There is also some suggestion of autobrecciation of a reddened lava flow.

On the slopes to the south of the chapel are hyaloclastites containing closely packed, large fragments (up to 0.25 m long) of dark, non-vesicular basalt interbedded with foliated tuffs containing broken, vesicular pillows. The smaller, dark, non-vesicular fragments that make up the majority of the hyaloclastite matrix are irregular in shape and were probably glassy. Further downslope from the chapel, but high in the volcanic sequence are found graded hyaloclastites and pillow breccias which represent the reworking and slumping of debris down the sides of the volcanic mound. The reworked volcanic debris probably travelled some distance away as, 4 km to the south in a small quarry near Kilworthy, is a lithic–crystal tuff with rounded, oxidized fragments of Brent Tor-type lava.

All the lava fragments are highly altered and oxidized basaltic material. In thin section some contain replaced microlitic and quenched skeletal plagioclase in an oxidized, magnetite-rich glassy matrix. Small, disrupted, often filamentous, originally glassy scoria may be bounded by internal vesicle walls and exhibit curving lines reminiscent of perlitic cracking. The finer hyaloclastite matrix appears to have been generally glassy, although much is now replaced by secondary hematite, prehnite, carbonate, sericite and sphene.

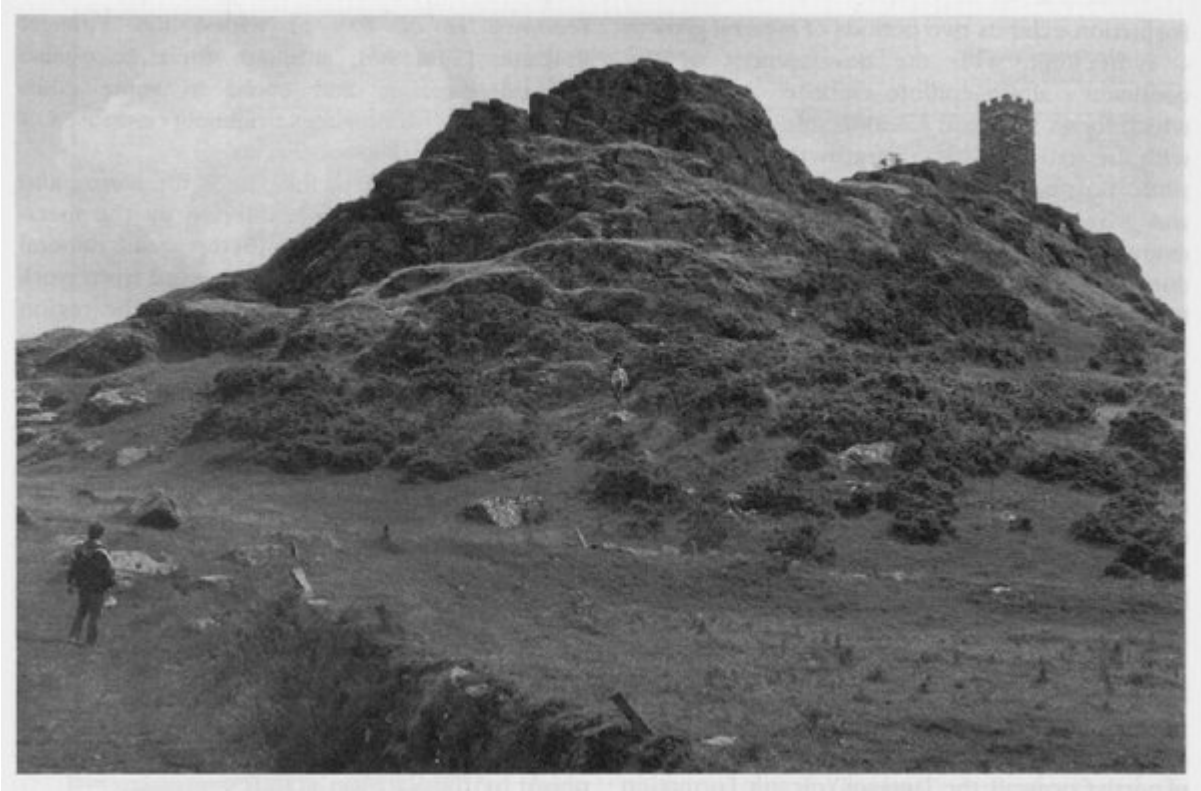
Interpretation

The importance of this early Carboniferous volcanic site is that it represents an excellent example of a hyaloclastite–pillow breccia mound and, relative to other volcanic localities (dominated by pillow lavas and minor volcaniclastic sheets), it is unique in this respect. The general shape and limited extent of the hyaloclastite deposit suggests a localized submarine eruption which built a high-level mound of largely unsorted, basaltic, glassy fragments and pillow breccias. The highly reddened or oxidized character of the lavas is unusual for Cornish volcanics and might indicate that the mound was built to a high level prior to penetration by oxygenated sea-water. The upper portion of the mound was reworked by current action and unconsolidated volcanic debris slumped downslope to form an apron. Thus, this volcanic structure is different from both late Devonian and early Carboniferous volcanic forms, which invariably exhibit pillow lavas, shallow sills or thin volcaniclastic sheets. The structure exposed probably represents the top part of a small seamount-type edifice on the floor of the basin, whereas pillow lavas in the area are typically small, domal bodies developed in a much deeper-water environment. Although its form is different from other volcanic products, it is chemically compatible in having an enriched alkali-basalt composition similar to both late Devonian and early Carboniferous volcanics in the same area.

Conclusions

This locality shows unique evidence for the presence of an early Carboniferous (around 350-million-year-old) volcanic seamount. Basaltic lavas and fragmentary volcanic material were erupted at a localized centre and built a small submarine volcano up to quite shallow depths. The rocks provide evidence consistent with eruption in a submarine setting: pillow lavas (see Chipley and Pentire Head above), glassy fragments formed by the rapid chilling of the lava by sea-water and irregular clinker-like clasts (scoria) full of voids produced by the evacuation of gases on cooling, together with cemented ashes (tuffs). The fact that they are now seen to be reddened is the result of exposure of the top of the seamount to the oxygenated upper levels of the sea and indicate its growth well above the contemporaneous sea-floor.

References



(Figure 4.39) The conical knoll of Brent Tor is composed of Lower Carboniferous basaltic pillow lavas and hyaloclastites which formed a near-emergent seamount with a reworked volcaniclastic apron. Brent Tor, Devon. (Photo: P.A. Floyd.)