B18 Trusham Quarry

[SX 846 807]

Highlights

At this locality, a metamorphosed dolerite is seen within an unthrust unit of early Carboniferous sediments. The chemistry and mineralogy of the dolerite is distinctive, together with the effects of local attendant hydrothermal alteration.

Introduction

This site includes the old water-filled quarry (originally known as Crockham Quarry) and the southern faces of the adjacent working quarry, 1.5 km due east of Hennock.

To the east of Dartmoor, the Teign Valley sedimentary succession ranges in age from the late Devonian through to the late Carboniferous, with the stratigraphically lower units falling within the metamorphic aureole of the granite. The early Carboniferous, in particular, is characterized by the presence of numerous massive greenstone sills (within one of which the site is located), together with relatively minor basaltic lavas and various volcaniclastics. The rocks in this area are autochthonous basinal successions (Sel-wood and Thomas, 1986b), comprising black argillites, well-bedded cherts, dark limestones and intercalated volcanics (the Foundation Unit of Waters, 1970).

The petrography of the dominant greenstone intrusives in the Teign Valley has been described by Flett (in Ussher, 1913), who referred to them as ophitic diabases with local quartz-bearing and highly feldspathic variants. Rare olivine is preserved only as serpentine pseudomorphs within pyroxene, whereas plagioclase is invariably altered to albite, together with variable prehnite, sericite, chlorite and calcite. As with other south-west England greenstones, the intrusives are now low-grade metadolerites. The progressive contact metamorphic effects due to the granite were also recorded within the greenstones. Some chemical work has been done on the massive greenstones in this area by Chesher (1969) and Morton and Smith (1971), and two major-oxide analyses were presented by Ussher (1913). In general terms, the dolerites are incompatible-element-rich, and they exhibit variable, but often well-fractionated suites belonging to the alkali-basalt magma type. They also exhibit typical intraplate chemical features that are characteristic for this magmatic province of south-west England (Floyd, 1983).

Description

The Trusham Quarry site is situated within a massive metadolerite body that intrudes the basal early Carboniferous Combe Formation (Chesher, 1968). It is just outside the aureole of the Dartmoor Granite. The sill-like intrusive nature of the 65–70-m-thick dolerite can be seen, with both the upper and lower contacts exposed. The body dips at about 45°-50° to the south-east. The site, however, only includes the upper contact, which can be seen at the base of the southern wall of the old, water-filled, Crockham Quarry, but can then be projected into the working quarry and is exposed in the quarry face at the upper levels. Although the contact is undulating, it is generally concordant with the sedimentary bedding. The local sediments are cleaved, blue-black argillites and buff siltstones with occasional thick sandstone units. The argillaceous sediments adjacent to the sill have been thermally metamorphosed with the development of randomly orientated, pale spots, a few millimetres in diameter, and small chiastolite prisms. The Na-metasomatism (adinolization) of the contact sediments, often a common phenomenon of high-level sills intruded into wet sediments, has not apparently taken place.

The greenstone is a mildly metamorphosed alkali dolerite characterized by primary purple titanaugite, ilmenite and abundant large apatite crystals. Original plagioclase has invariably been replaced by secondary albite and minor chlorite (penninite) and epidote. Green granular pumpellyite was tentatively identified in some plagioclase laths. Subhedral prisms of pyroxene may also be partially replaced by chlorite, which gives the rock its greenish tinge. The dolerite is

medium grained with a granular to intersertal texture, occasionally plagioclase-phyric and with pegmatitic patches developed towards the top contact. The proportion of mafic to felsic minerals may vary considerably, although a ratio of 40:60 is relatively common. At the contact with the sediments is a *c.* 2 m thick, chilled margin of green, chloritized basalt which is sometimes vesicular. Adjacent to oxidized joints and calcite veins, the normal green colour of the metadolerite is replaced by a pink coloration which is seen mainly in the plagioclase laths. This is due to the development of hematite produced by the oxidation of Fe in plagioclase by late hydrothermal solutions that passed through fractures in the rock.

During later tectonism, the intrusive mass suffered some internal deformation with the development of thrusts that enclose hydrotherm-ally argillized sediment and a highly oxidized wedge of dolerite with foliated margins. Vertical shears cut, and thus post-date, the shallow thrusts.

Chemical data on the Crockham metadolerite (Chesher, 1969) show that it has an alkaline composition and is characterized by very high incompatible element contents, especially Ti, P, Y, K, Rb and Ba.

Interpretation

The dolerite of this site is an example of an early Carboniferous intrusive within the autochthon of south-west England, whereas many of the other basic bodies are restricted to the allochthon, especially within the Greystone Nappe. One of its main features is that both contacts are exposed, and it shows the local thermal effects of contact metamorphism by such intrusives. Unlike many other Variscan dolerites, the adjacent sediments are not adinolized, but have developed spots and andalusite within the baked argillites. The lack of features indicative of intrusion into wet sediments suggests that the sill was intruded at some depth below the water–sediment interface and that the sediments were relatively dry and consolidated. It is probably this feature of the sediments that restricted the development of adinoles, whose extensive development appears to be related to intrusion at a high level into waterlogged sediments, such as is seen adjacent to the Dinas Head greenstone (above – B10).

In other respects the dolerite here is not typical of intrusives within the early Carboniferous; it has a granular–intersertal texture rather than ophitic, is often highly felspathic and is relatively well fractionated and chemically evolved. Like many of the early Carboniferous intrusives of the Teign Valley it is characterized by large and abundant apatite crystals that reflect the generally high P content of these basic magmas. However, overall it still exhibits chemical features typical of the early Carboniferous alkali dolerites of north Cornwall and Devon. One further feature is the nature of late hydrothermal alteration within the dolerite that caused a fracture-related pink coloration of the plagioclase. Whether these fluids were related to the granite is unknown, as no contact-metamorphic effects are seen in the immediate vicinity.

Conclusions

At Trusham Quarry can be seen a 60–70 m thick (metamorphosed) dolerite sheet intruded into muddy sediments during the early Carboniferous. Unlike other large bodies of similar age and composition, the Trusham intrusion is here in its original setting, and has not suffered lateral transport on the back of major thrusts sometimes many kilometres from their original setting (see Greystone Quarry above). Part of the interest of this intrusion is that, on emplacement, it thermally baked the adjacent sediments, with the development of a new phase, andalusite (an anhydrous aluminium silicate). The original mineralogy of the dolerite has been partly replaced by new minerals in response to low-grade regional metamorphism and localized hydrothermal fluids during the Variscan deformation episode. Chemically, the intrusion is incompatible-element-rich and, like many north Cornwall and Devon intrusions, belongs to the alkali-basalt magma series.

References