A10 Elender Cove–Black Cove, Prawle Point

[SX 769 353]–[SX 769 356]

Highlights

This is the best section through the highly deformed and metamorphosed oceanic basalts of the Start Complex.

Introduction

This locality lies on the west side of Prawle Point, the southernmost landward extremity of the so-called Start Complex (Figure 3.26). The southernmost peninsula of south Devon makes up this complex, which exhibits a range of variably schistose rocks of different aspect to the Lower Devonian argillites and phyllites to the north. The actual age of the complex is not known, although it is generally assumed to be Devonian (Dineley, 1986), with a structural history not dissimilar to that in south Cornwall generally (Marshall, 1962; Hobson, 1977). Many tectonic syntheses have suggested that the Start boundary fault is a continuation of the important Perranporth–Pentewan Line (Sanderson and Dearman, 1973; Sadler, 1974; Matthews, 1977) and that it is not linked to the Lizard–Dodman Thrust (Hendricks, 1939). In this context, the Start Complex junction has been interpreted as either:

1. originally a low-angle thrust that emplaced the Start Complex over the Devonian to the NNW (Coward and McClay, 1983);
2. a basement fault forming a terrane boundary to southern pull-apart, ocean-crust-floored, basins (Holdsworth, 1989).

Thus, apart from the special lithological characters of the magmatic rocks at this site, the whole complex has an important tectonic place in the early Variscan geology of South-west England.

The Start Complex exhibits two main groups of schists (Ussher, 1904; Tilley, 1923): metasedimentary micaceous greyschists and metavolcanic greenschists, together with minor variants of mixed sedimentary and volcanic character. The. greenschists exhibit two simple end-member mineral assemblages: chlorite–epidote–albite and hornblende–epidote–albite. Mineralogical and chemical data (Tilley, 1923) indicate that initially the greenschists constituted a series of basaltic lavas which were subsequently highly tectonized and metamorphosed to a low grade. Relative to the low-grade greenschist-facies sediments to the north, the Start Complex schists belong to the same intermediate P–T facies series, but were produced at slightly higher pressures (Robinson, 1981). Mite crystallinity and phyllosilicate cell parameters link the Start Complex metamorphic regime to that of south Cornwall generally, rather than the lower-pressure environment to the north of the Perranporth–Pentewan Line (Primmer, 1983b).

Early, major-element, chemical data established the basaltic character of the metavolcanic greenschists (Tilley, 1923), whereas trace-element data (Floyd, unpublished) indicates that they constitute a series of essentially undifferentiated tholeiites with a MORB chemical signature. This feature is clearly important in elucidating the tectonic evolution of south Cornwall during the Devonian, and it indicates that the Start greenschists originally constituted a volcanic segment of the Variscan ocean floor.

Description

The site comprises the steep cliffs and coves on the west side of Prawle Point; it can be reached via the coastal path. Typical lithological (and small-scale structural) features are well displayed in the section, with low-strain areas exhibiting greenschists in their least-deformed state.

The greenschists are fine to medium grained; they are characteristically schistose with fine banding produced by variations in mineralogy and grain size. Petrographically, they comprise associations of amphibole, chlorite, epidote, clinozoisite, albite and sphene, with accessory calcite, pyrite, quartz, white mica and iron oxides. Rapid changes in

lithology are common, with intimately interbanded chlorite-rich, epidote-rich and white mica-rich assemblages. Pyrite is abundant in some layers. Quartz is frequently present in the form of fine, banding-parallel metamorphic segregations or veinlets. Albite may form large (few millimetres-sized) porphyroblasts, which are emphasized by the weathering and stand out in relief on the rock surface. Small, resistant 'nodules' composed mainly of epidote and quartz are also characteristic of some layers, and these testify to element migration during metamorphism prior to the superposition of the enclosing deformed tectonic fabric. Tilley (1923), however, described similar epidote nodules as the metamorphosed products of infilled lava vesicles. It is unlikely that infill material would retain its nodular shape after the deformation suffered by the volcanics: it would be sheared out into lenticular bodies, as seen in less-deformed lava sequences.

Interpretation

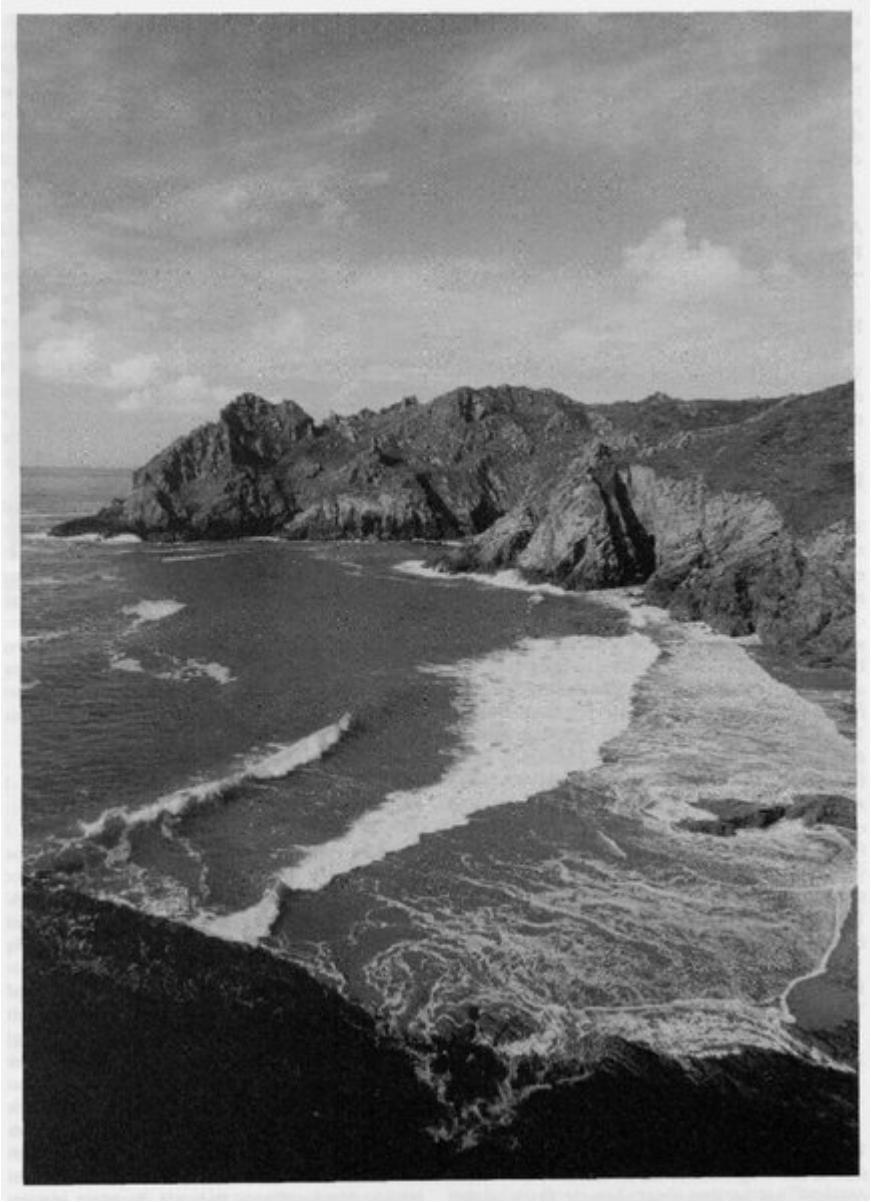
The original nature of the volcanics is problematic, and this is difficult to pronounce on this at this site, or indeed anywhere else in the Start Complex. Tilley (1923) suggested that the greenschists represented a series of basalt lavas and sills, although typical lava features, such as curved pillow-lava surfaces, have not be observed. The delicate nature of the fine laminations and rapid changes in lithology, especially in low-strain areas, strongly suggests that much of the sequence was composed of basaltic volcaniclastics (tuffs) rather than lavas. However, elsewhere the sequence shows greater variability in terms of gross banding, which could reflect original differences between lava flows, sills and tuffaceous material, all now heavily sheared to a degree of schistose uniformity.

On the basis of their lithological and chemical characteristics, together with tectonic considerations, the Start greenschists are related to the south Cornish nappe–thrust belt and compositionally have their counterpart in the basic rocks of the Lizard Complex and *mélange.* One of the most significant features of this site is that the greenschists are tholeiitic, with a depleted normal-type MORB chemistry, much more primitive than any ocean-floor basalt recognized in south Cornwall. In this respect they have affinities with some of the Lizard dykes and the Landewednack hornblende schists with depleted incompatible-element contents. Thus, one of the main reasons for the inclusion of a Start greenschist site is the tectonic significance of the MORB character of the metavolcanics. This suggests that they represent another segment of Devonian ocean crust at the western end of the Rhenohercynian Basin along with the Lizard ophiolite and MORB-like basaltic clasts within the *mélange.* Like the allochthonous units of south Cornwall with their remnants of ocean floor, the Start Complex was subsequently docked adjacent to the magmatically distinct Lower Devonian autochthon to the north.

Conclusions

Here occur highly deformed and altered rocks which were once basic rocks of volcanic origin. Their chemistry indicates that they are basalts with a composition similar to those currently forming at mid-ocean ridges. Rocks formed on an ancient ocean floor have little in common with basalts in the area to the north of Start or in Devonian volcanic sequences extensive in southwest England. They do equate, however, with basaltic rocks found in south Cornwall (including the Lizard Complex), being similarly formed as ancient ocean floor. Both areas, therefore, represent exotic terranes thrust and welded on to the margins of a northern continental plate in late-Devonian times.

References



(Figure 3.26) The rocky cliffs of Elender Cove expose metavolcanic greenschists of the Start Complex. Elender Cove, near Prawle Point, Devon. (Photo: David Noton Photography.)