B4 Carrick Du–Clodgy Point

[SW 507 414]–[SW 512 410]

Highlights

Pillow lavas and lava–sediment relationships within the Mylor Slate Formation are very well displayed here, as well as low-grade contact metamorphism and late-stage hydrothermal alteration of basic extrusives by Land's End Granite.

Introduction

Prior to the microfaunal discoveries of Turner *et al.* (1979), which confirmed a late Devonian age, the Mylor 'Series' of the Land's End Memoir was considered to be of early Devonian age on structural grounds (Dearman *et al.,* 1969). On the basis of the abundance of pillow lavas in this part of the Land's End aureole, however, Lacy (1958) had equated them with the well-documented Pentire Point pillow lavas of late Devonian age. Although it is now recognized that the two pillow-lava groups have different chemistries (Floyd, 1983, 1984) and tectonic settings, the lavas within the Mylor Slate Formation are, nevertheless, considered to belong to the parautochthonous Upper Devonian, and they are associated with the deep-water argillaceous facies within the Gramscatho Basin (Holder and Leveridge, 1986)

Description

This site is located along a stretch of about 1200 m of scenic coastline just to the north-west of St Ives and Porthmeor beach, in the outermost reaches of the Land's End Granite aureole. It comprises two low-lying headlands of small cliffs and gullies separated by a pebble beach, as well as a disused quarry in the pasture behind Carrick Du.

The site displays both vertical sections (Carrick Du) and northward-dipping platforms (Clodgy Point) of pillow lavas (Figure 4.10) together with some pelitic sediment and tongues of more massive lava. Many of the pillows are small, with cross-sections of only 0.2–0.6 m, although some horizons have clearly undergone a degree of tectonic flattening and shearing into phacoidal forms. Interpillow relationships show that they are the correct 'way-up', generally concordant with the sedimentary laminations, and that they dip about 20° to the north. The elongate tube-like structure of typical pillow-lava piles is not well developed, as many appear to be either of short length or individually bun-shaped, possibly developed towards the base of a submarine slope. There is little interpillow sediment within the main pillow horizons, although some discontinuous sediment horizons contain small, irregular, lava globules representing squirts of basalt magma into wet, partially consolidated, sediment (Figure 4.11). Although the pillow matrix is fine-grained, chilled margins are rarely preserved and vesicles uncommon. Some pillows, however, exhibit small pits or 'spots' which in thin section appear to represent the weathering out of cordierite por-phyroblasts, rather than true vesicles. Polygonal and transverse cooling cracks may be seen on the exposed top surfaces of some small bun-like pillows (Figure 4.12).

Apart from the pillow lavas and their sheared analogues, thin (1–3 m), high-level, sheet-like intrusives are also present which invariably show a tectonized contact with the metasediments. Hard, white massive and mylonitized adinoles, together with thin shear zones containing an admixture of brecciated and rolled adinole, pelite and greenstone fragments may be observed at sediment–greenstone contacts (Figure 4.13).

All the rocks now display a typical, low-grade, albite–epidote hornfels facies of contact-metamorphism mineralogy. The pelitic/semipelitic sediments are mainly laminated quartz–mica–chlorite and cordierite–biotite hornfelses, whereas the pillow lavas are fine-grained albite–actinolite hornfelses with no original magmatic phases left. Contact-metamorphic biotite may replace the actinolite and impart a purplish colour to the rock. The most distinctive feature of the basic rocks is the effect of granite-derived, late-stage hydrothermal fluids. This takes the form of pale, bleached patches and zones often closely associated with networks of pale-green amphibole veinlets. Mineralogically the 'bleached' matrix shows chloritization of amphibole and biotite, leucoxenization of ilmenite, and replacement of plagioclase by kaolinite.

Amphibole veinlets may also exhibit radiate groups of blue-green to dark-blue zoned tourmaline, both of which may be partially replaced by late epidote, calcite and rare axinite (Figure 4.14). These mineralogical replacements suggest that the initial Na–Mg–Fe-rich fluids subsequently became more Ca-rich.

Chemically, the pillow lavas of Clodgy Point are tholeiitic basalts with subhorizontal chondrite-normalized REE patterns and, in this sense, are not directly comparable with normal-type MORB (Floyd, 1984).

Interpretation

The importance of this site rests on the excellent examples of pillow lavas exhibited that typify the extrusives within the parautochthonous Upper Devonian of west Cornwall. They are evidence for submarine volcanism associated with the development of the deep-water facies of the Gramscatho Basin. Their limited stratigraphic occurrence and non-MORB chemistry indicates that true oceanic crust was not developed in this particular area of the Gramscatho Basin. Although they belong to the same magmatic province as other volcanics in south Cornwall, they are chemically distinct from the metabasalts of the *mélange* zone (Chapter 2) (Floyd, 1984). Moreover, their distinctive morphology and chemistry, in terms of specific incompatible-element ratios (e.g. Zr/Y), relative to other pillow-lava horizons at about the same stratigraphical level elsewhere within the aureole (e.g. Kenidjack Castle), sug gest that a number of separate volcanic centres were active at this time.

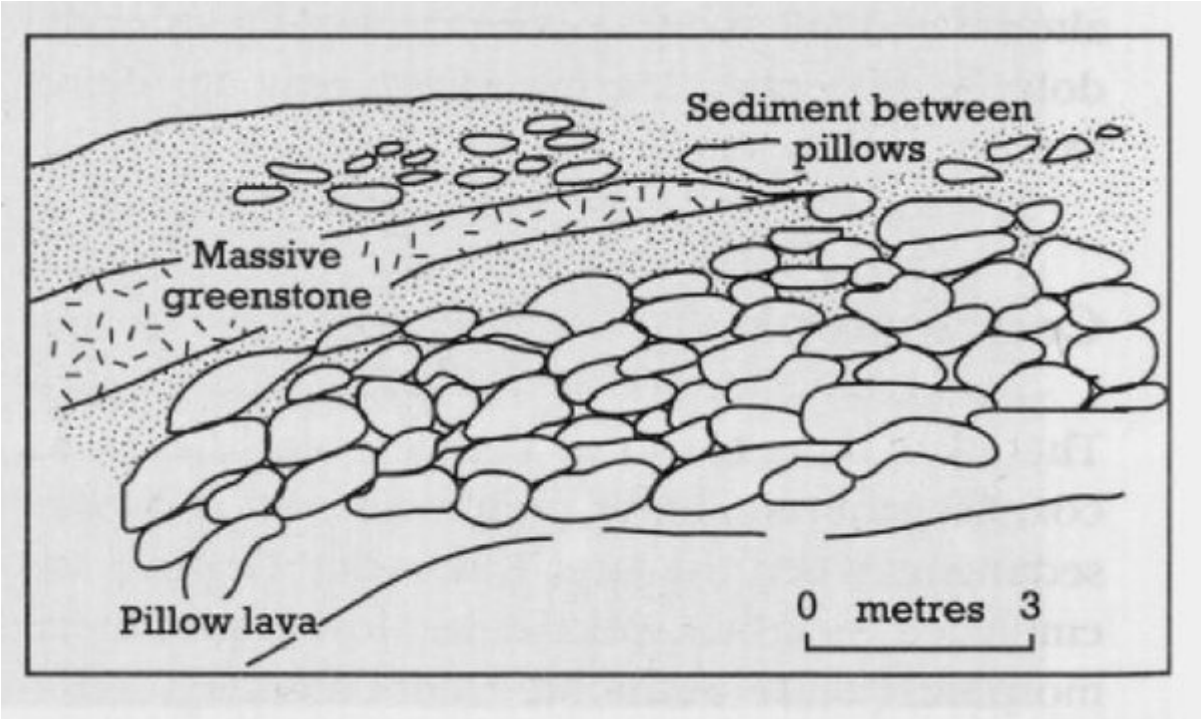
The other major feature of the site is the superimposed contact-metamorphic and late-hydrothermal effects, consequent upon the emplacment of the Land's End Granite, that have completely replaced the primary mineralogy and texture.

Conclusions

The sedimentary rocks here were originally deposited as clays and silts on a sea-floor during the late Devonian Period, around 370 million years ago. Contemporaneous with sedimentation are piles of submarine lavas that formed superimposed masses of bulbous tubes (or 'pillows') as they escaped from the vent or fissure on the seabed. The original basalt lavas have been subsequently altered chemically and mineralogically and now bear the imprint of contact metamorphism by the Land's End Granite. However, chemical data indicate that their original eruptive environment was probably in a basin underlain by continental crust rather than oceanic crust like the Lizard ophiolite.

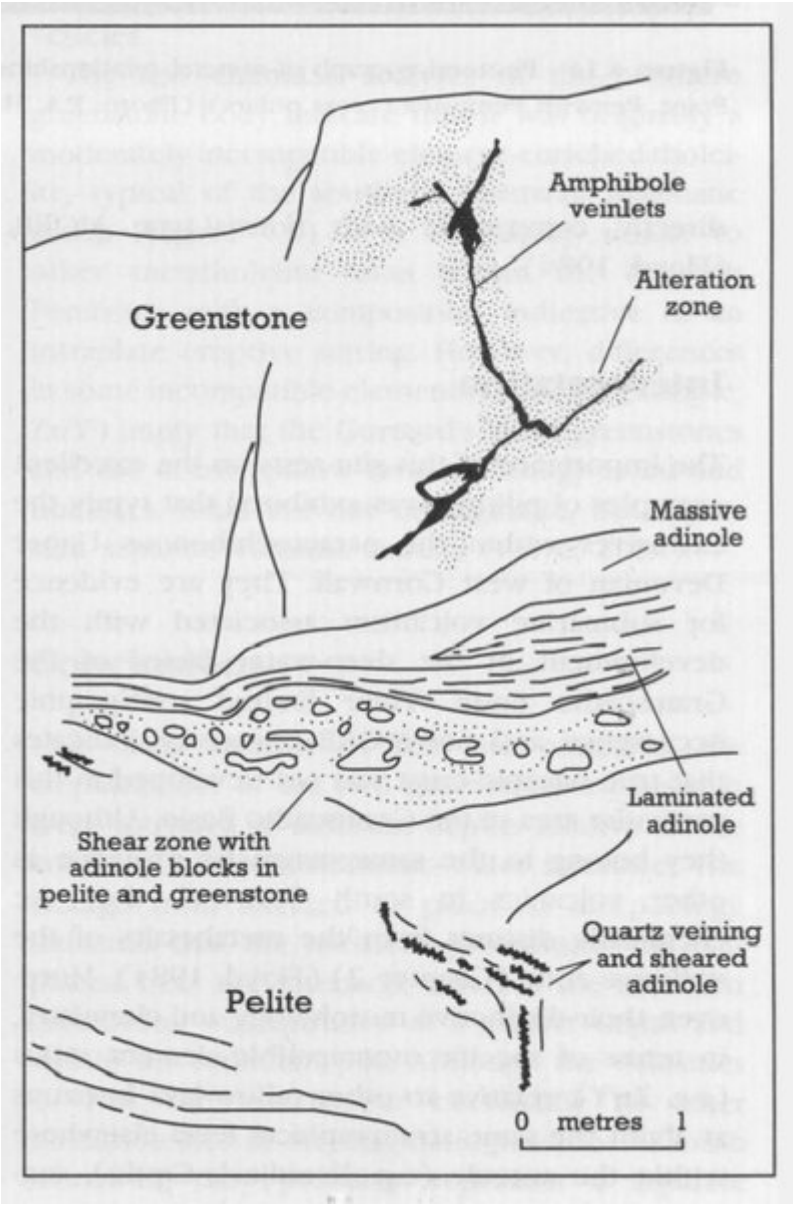
References

(Figure 4.10) View of the pillow-lava sequence at Clodgy Point, Penwith, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.11) Relationship between Upper Devonian pillow lavas and interlayered pelitic sediment, Clodgy Point, Penwith Peninsula.

(Figure 4.12) Polygonal cooling cracks on pillow-lava sequence at Clodgy Point, Penwith, Cornwall. (Photo: P.A. Floyd.)



(Figure 4.13) Sketch of the tectonized contact between adinolized sediments and greenstone, Clodgy Point, Penwith Peninsula.

(Figure 4.14) Photomicrograph of mineral relationships in late amphibole-rich hydrothermal veins, near Clodgy Point, Penwith Peninsula (cross polars). (Photo: P.A. Floyd.)