B10 Dinas Head–Trevose Head

[SW 847 761]–[SW 850 766]

Highlights

This site is the best in south-west England and a classic in Britain for the study of the progressive development of adinole at the contact between a dolerite intrusion and its enclosing sediments.

Introduction

This scenic coastal site includes the rocky, terraced cliffs of Dinas Head from Mackerel Cove to Stinking Cove, and the rock platforms around Trevose Head lighthouse (Figure 4.28). The old quarry at the back of Stinking Cove is also included.

Apart from the massive intrusive greenstone which was described by Reid *et al.* (1910) and later by Agrell (1939), interest in this site has centred on the contact effects of the body on the adjacent sediments. One of the characteristic features of some large, sill-like intrusions, is the development of a narrow contact aureole of intensely Na + Si-metasomatized sediments called spilosites and adinoles. Fox (1895) initially noted the development of these adinoles as metasomatized sediments, whereas their particular pseudospherulitic texture was commented on by McMahon and Hutchings (1895). The Dinas Head adinoles were also mentioned by Dewey (1915) who demonstrated the importance of sediment composition in the production of adinoles, with Fe^{3+}-poor, grey and black argillites being readily altered to adinoles. A more extensive survey of adinolization in the area (Agrell, 1939, 1941) showed that the abnormally large metasomatic zone at Dinas Head was a function of the intimate penetration of the sediments by many sill-like offshoots from the top of the intrusive mass.

Description

The sedimentary rocks here are laminated Upper Devonian black and blue-grey argillites; they form part of the Port Isaac Nappe (Selwood and Thomas, 1986a). The sediments occupy the rib of Dinas Head, although as sea-level is approached, they become progressively metasomatized and penetrated by tongues of greenstone (metadoler-ite). The sedimentary rocks/greenstone junction is often irregular with random ramifications and entrapment of sedimentary wedges. The first effects seen of contact metamorphism are the development of chloritic and incipient cordierite spotting, as well as the growth of andalusite prisms (Agrell, 1939). Partially metasomatized argillites (spilosites) retain the original slaty cleavage, but show the development of quartz–chlorite and porphyroblastic albite 'spots', together with tourmaline and leucoxene. Completely metasomatized argillites (adinoles) consist largely of quartz–albite assemblages with variable carbonate content. Original spots and andalusite are now pseudomorphed by quartz–chlorite or carbonate–chlorite. The progressive metasomatic changes are well displayed in a section from the top of Dinas Head down to sea-level towards the intrusive. However, spilosites and adinoles may often be interbedded, reflecting changes in the original composition of the sediments rather than distance from the intrusive contact. A number of different textural types have been recognized in the metasomatized sediments by Agrell (1939).

The majority of the greenstone is a fine- to medium-grained, subophitic alkali metadolerite with occasional relicts of primary clinopyroxene set in an altered low-grade matrix. The pyroxene may be partially replaced by a fringe of uralitic actinolite or completely pseudomorphed by actinolite and chlorite. Plagioclase is now albite, but may also be replaced by sericite, epidote, prehnite and carbonate. Chlorite, albite and carbonate are common secondary minerals throughout the finer-grained marginal facies. Skeletal ilmenite may be leucoxenized or rimmed by replacive sphene granules. Apatite needles are relatively rare.

The general shape of the greenstone mass appears sheet-like, but its junction with the sediments is very irregular on the medium scale (several metres) and a number of separate large tongues penetrate the sediments to the north and south of Dinas Head. In the quarry, which is topographically above the Dinas Head part of the greenstone, the very high-level nature of the upper surface can be demonstrated. Much of the greenstone here is very fine grained and contains flattened and aligned chlorite-filled ovoid vesicles. Small wedge-shaped rafts of laminated and adinolized sediments are also present within the greenstone, which shows irregular cuspate margins indicative of intrusion into water-bearing, partly consolidated, sediment. Fallen blocks lying on the quarry floor exhibit pillow structure with small, surface-aligned vesicles in the rim zone and larger, circular vesicles in the pillow core. The top of the quarry also exhibits a number of thrusts that separate the fine-grained marginal facies of the greenstone from black, unaltered (non-adinolized) laminated sediments. The thrusts trace an irregular surface over the resistant greenstone, below which may be heavily quartz veined and sometimes foliated at the junction.

Interpretation

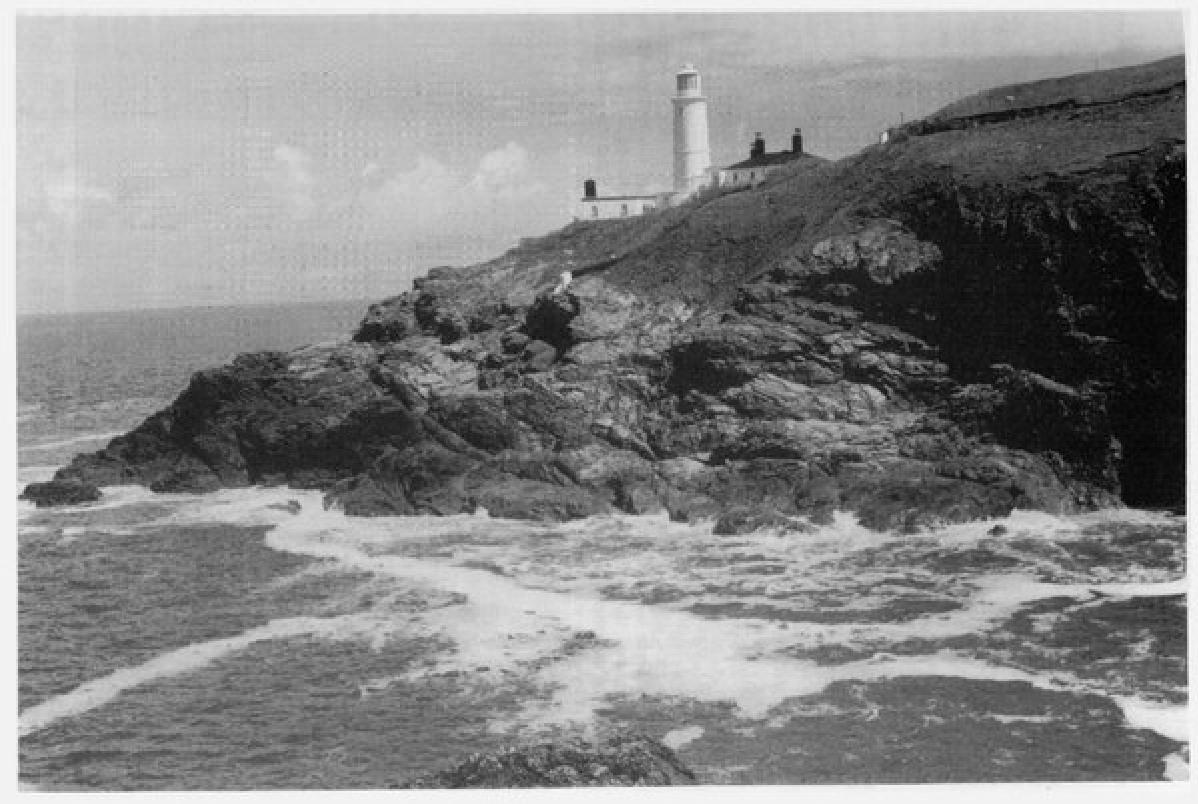
Agrell (1939) considered the Na + Si-rich metasomatizing fluids were derived from the basic igneous rock, driving all other constituents out of the adjacent sediments and precipitating albite and quartz. However, one feature not mentioned is that there is evidence for soft-sediment deformation at the margins of the body, suggesting that intrusion was into only partly consolidated sediments. These would still have retained sea-water in sediment pore spaces, which could have become an active metasomatizing fluid on heating by the intrusion. In this model, the metasomatizing agents are obtained from the sediments and not the basic intrusion. In general terms, therefore, extensive adinolization appears only to be developed adjacent to high-level massive bodies where there is evidence for intrusion into partly consolidated wet sediments. In other cases, where the intrusion took place at a deeper level and the sediments are relatively 'dry', only isochemical thermal effects are observed adjacent to massive bodies.

One of the main features illustrated by this greenstone is its irregular nature and evidence for high-level intrusion into partly consolidated sediments. The large size of the body and the degree of lateral penetration into wet sediments are probably the main reasons for the extensively developed contact zone of adjacent metasomatized sediments. The development of the adinoles and spilosites is of considerable significance as they represent one of the few classic British occurences of such metasomatized rocks and certainly the best example in the Variscan of south-west England. However, it has been generally assumed that the metasomatic fluids were derived from the igneous body itself, whereas a more likely mechanism is that they were mobilized by the heat of the intrusion from within the wet, partly consolidated, sediments. In this context the nature of the contacts with the sediments and the general shape of the body is considered important.

Conclusions

Here is seen a large irregular, high-level intrusive 'greenstone' body (originally a dolerite) that was emplaced into and altered the still wet and unconsolidated enclosing sediments. The hot magma not only deformed the sediments but caused localized chemical changes in their bulk composition (metasomatism). Some of the less-altered or metasomatized sedimentary rocks still retain their original sedimentary laminations (termed spilosites), whereas others have nothing remaining of their original texture or minerals (termed adinoles) and are totally replaced by new phases. This is an important site at which to study the effects of thermal and chemical change caused by basic intrusions on adjacent fine-grained sediments.

References



(Figure 4.28) (Opposite) Wedge of argillite (pale-coloured cliffs) resting on dark intrusive dolerite near sea-level. Trevose Head, Cornwall. (Photo: P.A. Floyd.)