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## B11 Trevone Bay

[SW 890 762]

### Highlights

This locality provides the best exposure of one of a suite of unusual, hydrous, potassic metadolerites found in north Cornwall. The pumpellyite facies of regional metamorphism is also well seen.

### Introduction

The intrusive body constituting the interest of this site is located in the small cliffs and rock platforms along the east side of Porthmissan beach towards Roundhole Point.

The majority of the massive intrusive greenstones of the Variscan were originally subophitic dolerites with a primary anhydrous mineralogy. Both tholeiitic and alkaline types are present, with the latter restricted to north Cornwall and Devon. However, apparently confined to the Upper Devonian are another set of greenstones that are mineralogically and chemically distinct and referred to as 'proterobases' or 'minverites' (after the type locality at St Minver, north of Wadebridge) in the early literature (Reid *et al.*, 1911; Dewey, 1914). This suite is characterized by having a primary hydrous assemblage and an overall alkaline composition and features (in fresh samples) high levels of large-ion-lithophile elements, such as K, Rb, Ba and the light-REE (Dewey, 1914; Floyd and Rowbotham, 1982). Relative to the commoner greenstone type of anhydrous sodic metadolerites, these rocks can be classified as hydrous potassic metadolerites.

The site illustrates an example of this greenstone type; it is situated within the grey, Upper Devonian slates of the Port Isaac Nappe. The presence of secondary prehnite and aluminous pumpellyite, along with other alteration minerals, in the greenstone indicate that the area reached the pumpellyite facies of regional metamorphism during the Variscan Orogeny (Floyd and Rowbotham, 1982).

### Description

The sill-like basic body here is very variable in texture and grain size, grading from fine-grained, granular dolerite to subophitic gabbro containing large, lustrous black clinopyroxenes, that often weather out on joint surfaces. The central portion of the body may have irregular pegmatitic zones, these were initially composed of large clinopyroxene prisms (5–10 mm long), but are now invariably replaced by green chlorite. Although altered to varying degrees, petrographic relationships between the main primary phases are easily discernible, and these illustrate a crystallization history under falling temperature and increasingly hydrous conditions. Minor original olivine (now occurring as chloritized ovoids) is totally enclosed in large plates of titaniferous clinopyroxene (salite) that have been selectively replaced, in a magmatic reaction relationship, by brown kaersutite (Figure 4.29). The amphibole may also be fringed with titaniferous, dark-brown biotite of magmatic origin. Microprobe analyses of the primary amphibole by Floyd and Rowbotham (1982) showed that it was a kaersutite, rather than barkevikite or brown hornblende as reported in the earlier literature (for example, Dewey, 1914). Mineralogically, the rock is characterized by the titaniferous nature of the major mafic phases, as well as the abundance of large, cored apatite crystals. Apart from the primary mineralogy, the metadolerite also exhibits a secondary assemblage typical of the pumpellyite facies of regional metamorphism (Floyd and Rowbotham, 1982). Together with the characteristic prehnite and colourless pumpellyite (Figure 4.30), albite, chlorite, actinolite, sphene, muscovite and epidote are also present.

Although the greenstone has a sill-like intrusive form, the upper fine-grained contact at Round-hole Point appears to be pillowed, with minor adinolization of the adjacent sediment. However, the contact zone is complex and both greenstone and sediments have been sheared and brecciated. The greenstone is often tectonized, with the development of a

schistose fabric within which are resistant phacoids of coarser metadolerite, whereas the sediments show rolled adinole and rusty, pyritous sandstone phacoids set in a grey fine-grained matrix. However, where an actual contact is visible it is very irregular and often cusped, suggesting intrusion into wet sediment.

## Interpretation

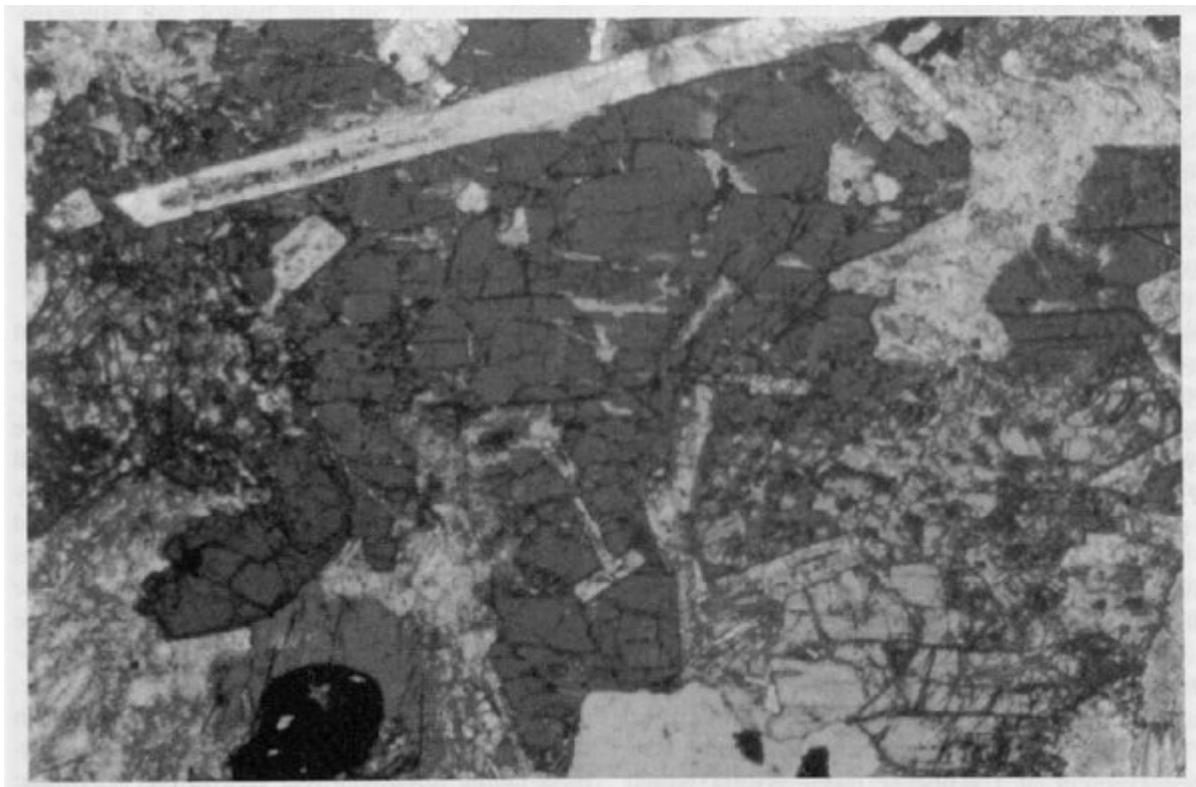
This site illustrates one of the more unusual intrusive greenstone types found within the Variscan of south-west England. It is mineralogically and chemically distinct from the more normal alkaline sodic dolerite of north Cornwall and Devon, being characterized by a primary hydrous assemblage (amphibole and biotite) and enrichment in the large-ion-lithophile elements (K, Rb, Ba, light-REE). In particular, the major mafic minerals are highly titaniferous, the ore phase is ilmenite and abundant cored apatites are features typical of this potassic dolerite suite. These intrusives appear to be emplaced only in Upper Devonian strata and are particularly common in the north Cornish area of the Port Isaac Nappe. It is speculated here that some of the water available for the primary crystallization may have been sea-water that penetrated the original magma chamber which fed these high-level intrusions.

The other main feature of this site is the presence of a secondary assemblage which indicates the area underwent relatively low-grade pumpellyite-facies metamorphism during the Variscan. The secondary alteration of basic rocks can be used to determine metamorphic facies and in this respect shows that the grade here was lower than the greenschist facies of the Tintagel area just to the north-east (Primmer, 1982), although similar to south Cornwall.

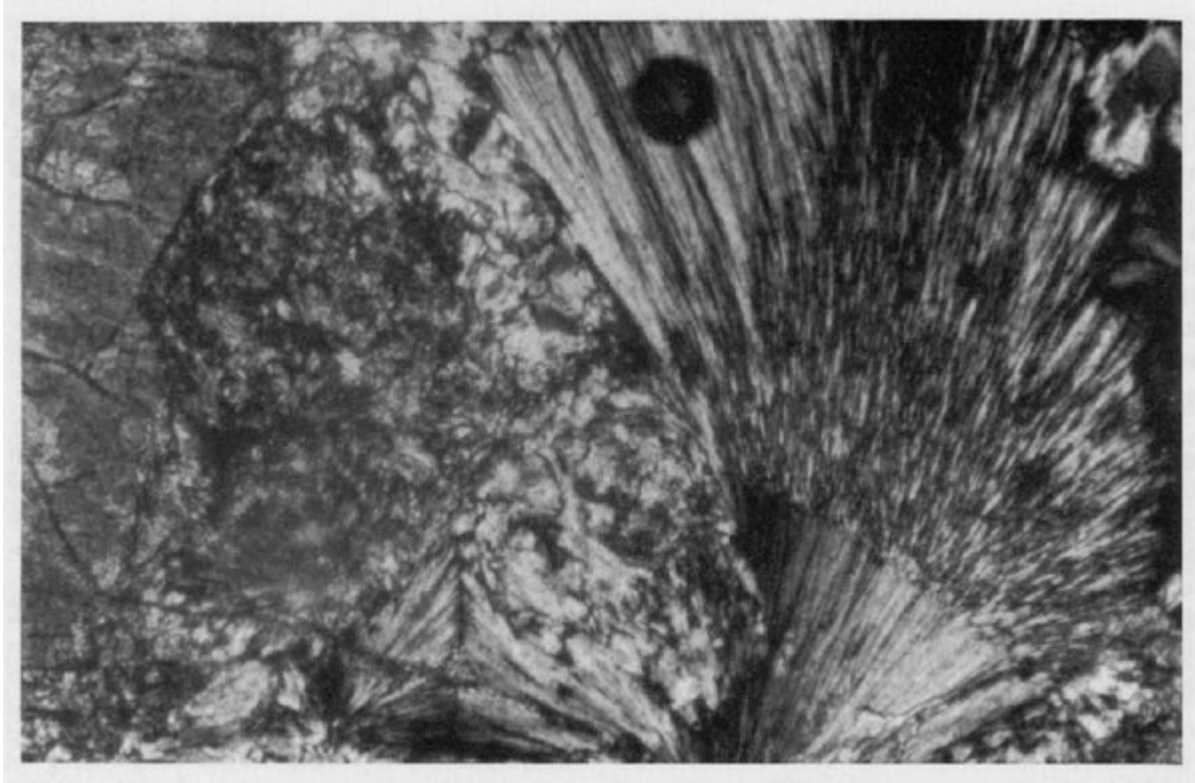
## Conclusions

At Trevone Bay, a massive greenstone (altered dolerite) intrusion can be seen, which still preserves evidence of the original mineral assemblage that crystallized from the magma. In addition to the usual olivine–pyroxene–plagioclase, this assemblage is distinct from other intrusive dolerites in containing primary hydrous phases (amphibole and biotite) and abundant apatite. These features indicate that the melt contained abundant water possibly derived from sea-water that leaked into the magma chamber situated at a high level in the crust. The other primary characteristic is the enrichment in many trace elements (K, Rb, Sr, Nb, Zr and P) that indicates that these rocks were derived from a distinct mantle source relative to other greenstones.

## References



*(Figure 4.29) Photomicrograph of a hydrous dolerite showing large irregular crystal of dark, primary, kaersutitic amphibole replacing colourless clinopyroxene (bottom right); long needle-like apatite crystal traverses the amphibole unaltered (top). Trevone Bay, Cornwall. (Photo: P.A. Floyd.)*



*(Figure 4.30) Photomicrograph of a hydrous dolerite showing the fan-like growth of secondary Al-rich pumpellyite that replaced the original plagioclase. Trevone Bay, Cornwall. (Photo: P.A. Floyd.)*