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## B2 Cudden Point–Prussia Cove

[SW 548 275]–[SW 555 278]

### Highlights

The massive, zoned metadolerite/gabbro at this site is the best exposed of the south Cornish sills; its chemical composition is unique within that group. Low-grade regional metamorphism is typical, but an unusual, axinite-bearing, vein assemblage probably reflects the influence of the nearby Godolphin Granite.

### Introduction

The site covers the rocky rib of Cudden Point headland and the adjacent coves and gullies from Arch Zawn in the west to Bessy's Cove in the east, as well as small exposures inland. The intrusive greenstone seen at Cudden Point is not only representative, but one of the best exposed of the massive sill-like basic bodies seen along the south Cornish coast. It is situated within the Porthleven Breccia Member of the Upper Devonian Mylor Slate Formation (Holder and Leveridge, 1986). Although once interpreted as one limb of a broad fold on the older Geological Survey maps, this is no longer considered to be the case, as the intrusion is terminated by an approximate east–west tectonized contact with the adjacent sediments behind the headland (Figure 4.6). Previous work has largely involved petrographic and geochemical studies (Floyd and Lees, 1972; Floyd and Fuge, 1973; Floyd, 1976; Floyd and Al-Samman, 1980), which revealed the primitive tholeiitic nature of the sill relative to the alkaline composition of many south-west England greenstones.

### Description

This intrusive body is typical of massive greenstones, with the preservation of good relict textures and primary minerals that indicate that it was originally an internally differentiated dolerite. Dark-green olivine–clinopyroxene cumulates are present, together with gabbroic pegmatites within the central portion of the sill, and minor granophyric pods.

The lower tectonized contact is exposed in Arch Zawn and Piskies Cove adjacent to deformed and foliated Mylor phyllites and semi-pelites. At Arch Zawn, the southward-dipping sheared contact is subparallel to the dominant axial-planar cleavage within the metasediments; a number of small shear zones within the dolerite body have a similar trend. In the east near Little Cudden, the greenstone is highly sheared, with about 30–40 m of a pale-green, albite–chlorite–actinolite schist showing an irregular, possibly folded, contact with the adjacent metasediments. At the extremity of Cudden Point proper is a pale-grey semipelitic metasediment raft with near-vertical tectonized margins, that was probably incorporated during intrusion, as the dolerite is chilled against its margin. Other interesting contact features include various mineral veins developed parallel, as well as oblique, to the main metasediment foliation, with the assemblage axinite–calcite–tremolite–chalcophyrite, and bi-mineralic veins of tremolite with either quartz, plagioclase or actinolite. The Ca required for these veins was probably mobilized from the dolerite during shearing. Axinite, however, is a Ca- and B-bearing mineral typical of contact metamorphism adjacent to potassic granites, and it is rare outside the visible contact aureoles of south-west England. Thermally developed chlorite spots may also be seen in the more pelitic metasediments near the contacts, although this may not have been induced by the dolerite, as spotting is often developed on a regional scale in west Cornwall, reflecting the influence of hidden granite ridges.

The foliated margins of the sill are now pale-green albite–chlorite–actinolite schists, whereas the major part of the body is a metadolerite that grades into a metagabbro. Central portions of the sill exhibit large relict plates of primary augite that are invariably fringed by fibrous actinolite (Figure 4.7). Sometimes, very thin exsolution lamellae of pigeonite may be observed within the larger clinopyroxenes. Towards the sill margins, clinopyroxene is invariably replaced, either partially or totally, by actinolite, in common with a general increase in the degree of alteration. Chlorite ovoids within the augite and matrix probably represent pseudomorphs after early olivine. Apart from the augite relicts and skeletal ilmenite, the only other primary phase is a rare, brown magmatic amphibole that is always replaced along its margins by zoned

blue-green to colour. less secondary actinolite. The presence of a primary hydrous phase is unique in these greenstones, and proves that the original magma contained some water and was not a typically anhydrous tholeiitic melt. Alteration domains of secondary minerals are common within the outer portion of the sill and are dominated by chlorite–epidote–white mica with all original plagioclase now replaced by albite. Pumpellyite has not yet been recorded.

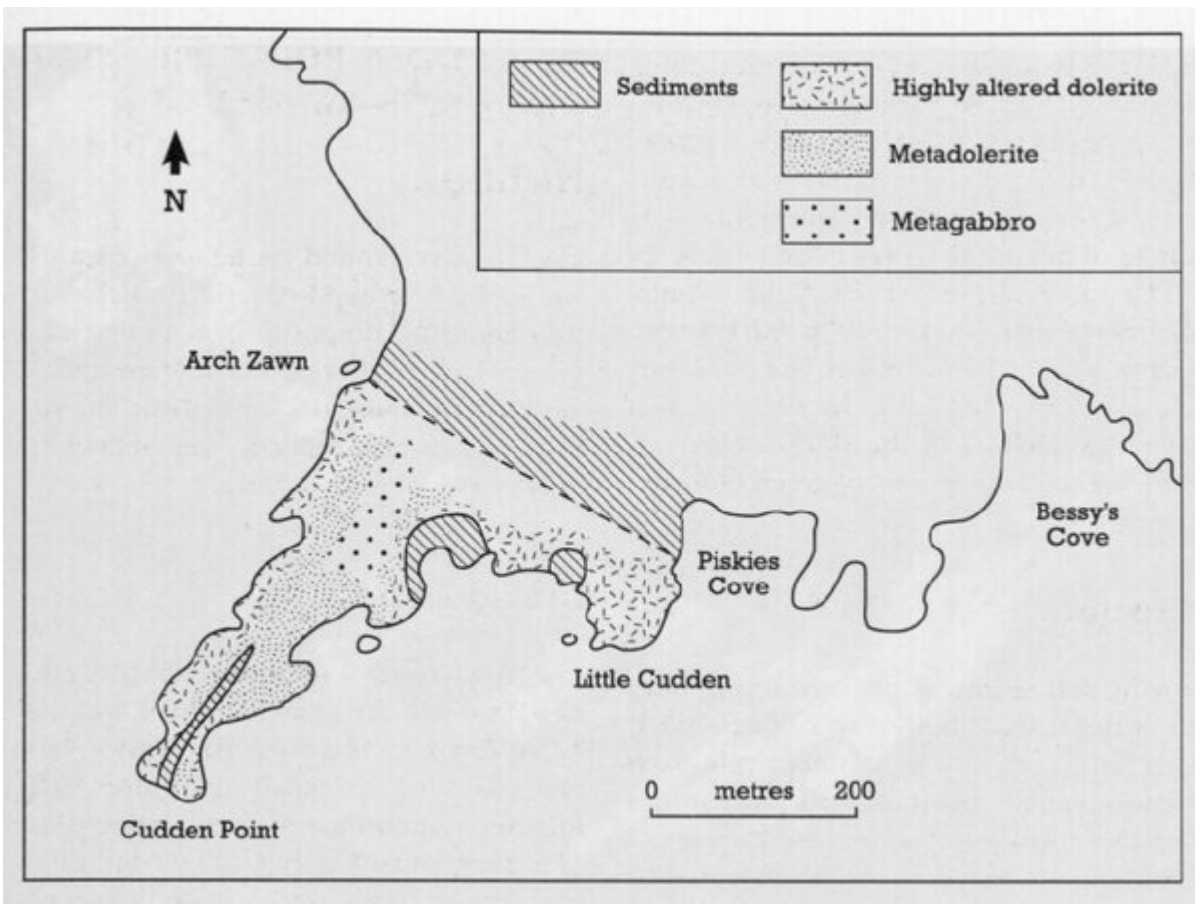
## Interpretation

This greenstone is unique among the south Cornish intrusives in having a chemically primitive tholeiitic composition with low incompatible-element and high Mg, Ni, Cr and Sc abundances. These features suggest that the magma was probably derived by relatively high degrees of melting (c. 25%). Incompatible-element ratios, such as Zr/Y and Zr/Nb, can be matched with the extrusive suites which make up the south Cornwall magmatic province (Floyd, 1984; see (Figure 4.2) above). The wide range of Cr (c. 700–50 ppm) and Ni (c. 600–50 ppm) values indicate that chemical variation was governed by mafic fractionation and dominated by the accumulation of olivine and clinopyroxene (Floyd and Al-Samman, 1980). One further feature of chemical interest is the strong enrichment of the marginal foliated facies in K, Rb, Cs, Li, F and Cl (Floyd and Lees, 1972; Floyd and Fuge, 1973), which, together with the presence of spotting and veins exhibiting typical aureole minerals (for example, axinite), suggest the effects of contact metasomatism. It is likely that granite-derived fluids, possibly from a hidden, shallow extension of the nearby Godolphin Granite, penetrated the sill via the channel-ways afforded by the sheared margins.

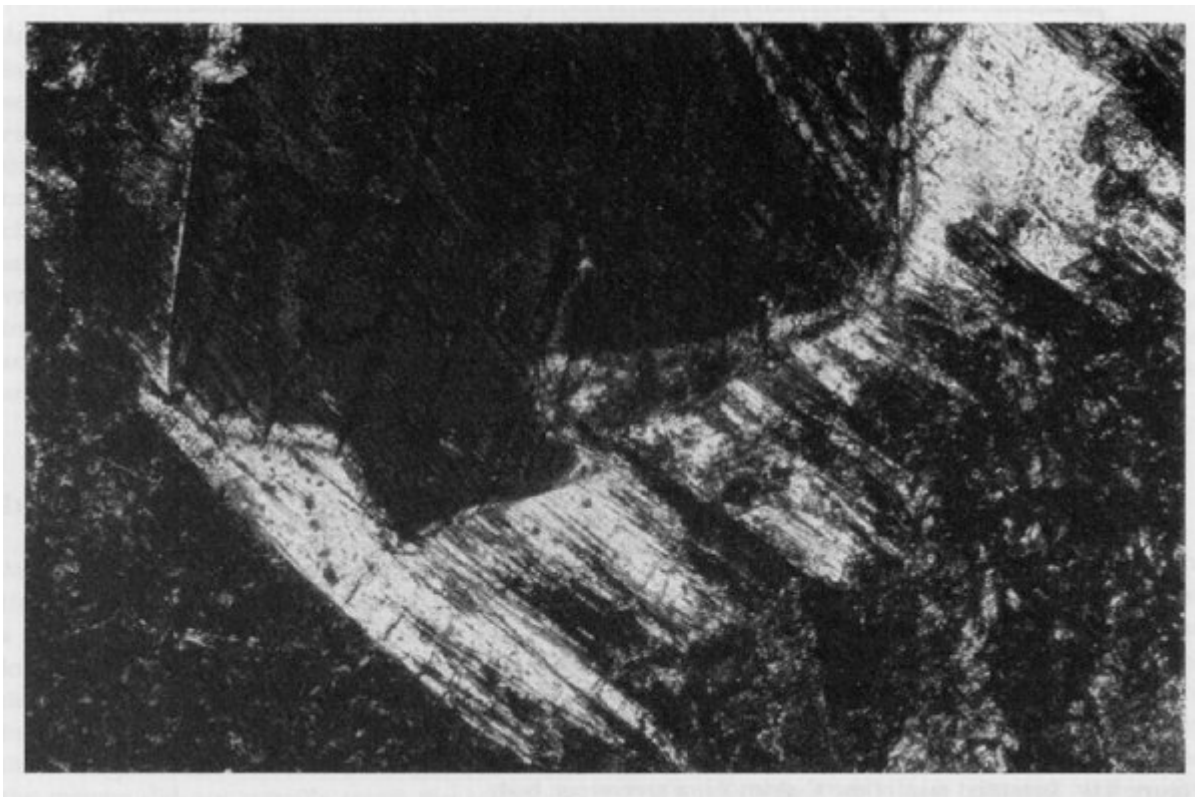
## Conclusions

The Cudden Point Sill is typical of the massive greenstone intrusives found in south Cornwall, but it has some unique chemical and mineralogical features. It is a chemically primitive, olivine-bearing tholeiite, internally differentiated, with a textural variation governed by the differential cooling of a massive body. That the magma became hydrated on crystallization, is indicated by the presence of rare brown amphibole – until recently only recorded in the alkali dolerites of the north Cornish coast near Padstow. The degree of alteration was governed by distance from the locally sheared contact, although alteration domains are patchily developed through the body. The marginal fades provides evidence for alkali-element and F–B metasomatism from a nearby granite source.

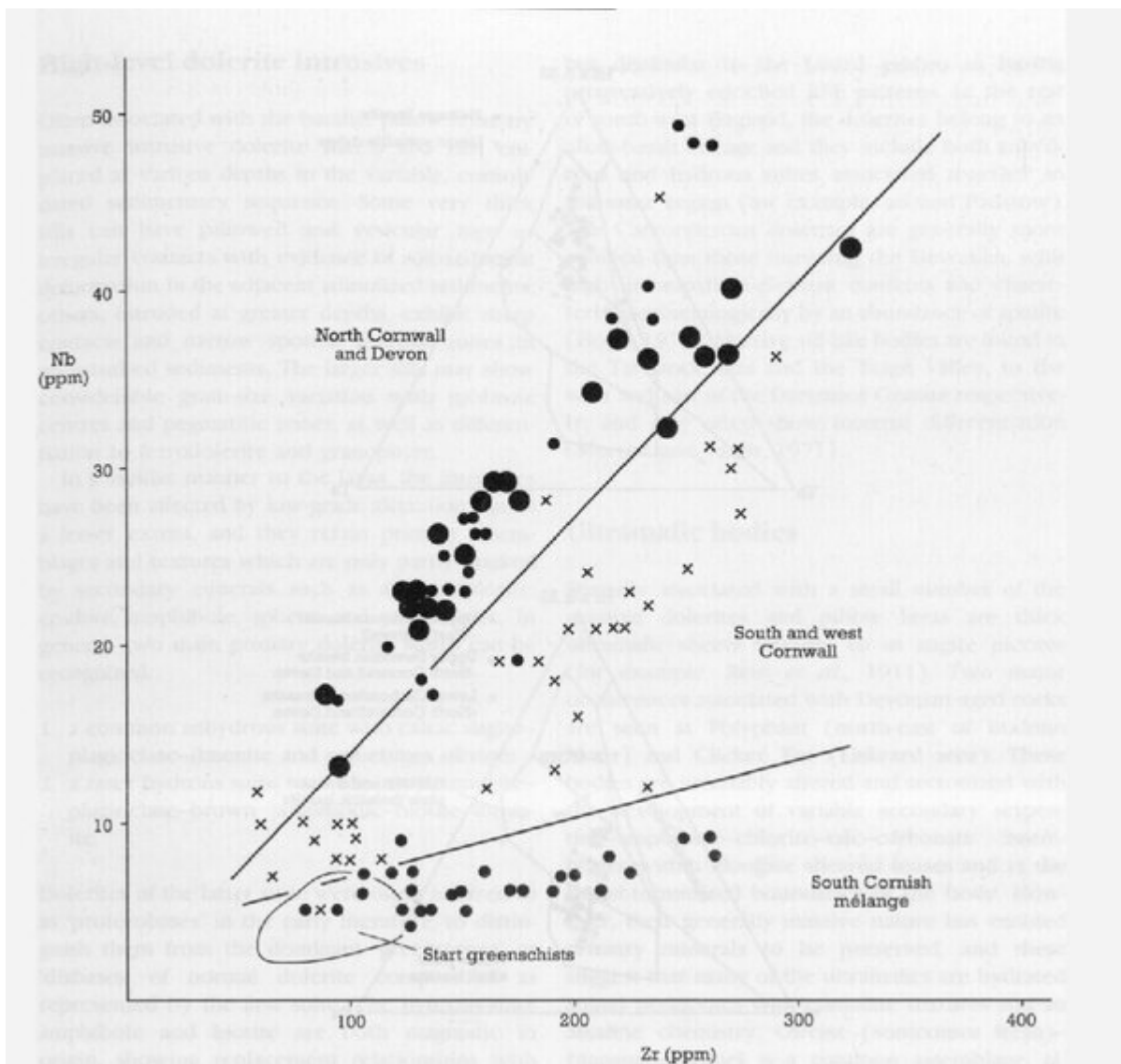
## [References](#)



(Figure 4.6) Simplified map of the Cudden Point greenstone body.



(Figure 4.7) Photomicrograph of the coarser facies of the Cudden Point greenstone showing primary augite partly replaced by a fringe of actinolite (cross polars). (Photo: P.A. Floyd.)



(Figure 4.2) Variation of Zr and Nb in Upper Devonian (small dots and crosses) and Lower Carboniferous (large dots) basaltic lavas relative to different geographical regions. Data largely from Floyd et al. (1983) and unpublished.