A8 Lankidden

(SW 756 164)

Highlights

An important high-temperature shearing event that occurred shortly after the emplacement of the Lizard gabbro is best developed at this locality.

Introduction

The cliffs around the prominent gabbro headland of Lankidden have many spectacular geological exposures but they have received only passing interest from most previous workers. Teall (1886, 1888) described the 'beautiful augen structure in the gabbro' and Flett and Hill (1912) mentioned that there were numerous gabbro dykes to either side of 'the great spectacular dyke of Carrick Luz' (the rocks at the southern tip of Lankidden). Green (1964c) also noted these features and suggested movement of the dyke walls during intrusion had produced them. Kirby (1979b) interpreted it as a feeder to the main Crousa gabbro magma chamber. Styles and Kirby (1980) suggested that the thrusts seen here represented the major thrust zone that separated an upper, eastern tectonic unit from a lower western unit. Bromley (1979) had, however, maintained that the thrust was further east at Poldowurian just east of Kennack. Recent work further north, inland by Leake *et al* (1990), suggests that there is little evidence for a major thrust or the existence of the two major tectonic units, and that the thrusts, although spectacular at Lankidden, are only of local importance.

Description

The cliff-bounded headland of Lankidden, with the site of a Bronze Age castle at the southern tip, is an area of outstanding beauty. The headland is largely formed of a sheet or dyke of coarse gabbro around 100 m in thickness and dipping around 45° to the east. In most places the contacts with the peridotite are highly sheared; they can be seen in Spernic Cove to the west and Lankidden Cove to the east (Figure 3.20).

The peridotite is the coarse, primary type, with prominent orthopyroxene crystals, up to 5 mm in size, in a matrix of partially serpentinized olivine. A coarse, rough foliation is present that is essentially vertical and trends north–south.

In Spernic Cove, the western contact between the peridotite is not a sharp one and there are numerous inclusions of peridotite within the gabbro and thin gabbro veins in the peridotite below the main contact (Figure 3.21). The foliation in the Baser gabbro dips at around 45° to the east. This sheared contact is truncated by one of the many late faults at the small cove on the west side of Lankidden; it is presumably offset out to sea as it is not seen further south on the headland.

The outcrops further south on this west side, show a superb range of features produced by the high-temperature deformation of a coarse-grained gabbro. At one end of the range are the coarse, augen-bearing, Baser gabbros (Figure 3.22), with augen of clinopyroxene up to several centimetres in size, in a fine schistose matrix of recrystallized plagioclase and pyroxene. Thin sections show that the augen of clinopyroxene are now partly altered to hornblende. Much plagioclase is now saussuritized, although some fresh crystals remain in rocks that have large feldspar porphyroblasts. The presence of pyroxene shows that temperatures must have been at least 600°C during deformation. Where the rocks have been deformed to a greater degree, a considerable reduction of grain size has taken place, and fine 'gabbro schists' give way to streaky mylonites in the zones of most intense shearing (Figure 3.23). All these features can be seen within a few metres of each other, at many places along the west side of Lankidden, but are perhaps best exemplified in the small gully, near the southern tip. Late, basic dykes can be seen cutting through the shear zones.

Along the eastern side of the headland, access is more difficult and relationships more complex. This appears to be the intensely gabbro-veined 'hanging'-wall of the main intrusive sheet, and there are numerous small shears and gabbro veins. Both the peridotite and gabbro are intensely hematized, and this can make identification of rock types difficult.

The small rock promontory in the centre of Lankidden Cove, to the east of the headland, has the best examples on the Lizard of the dunite veins that cut through the peridotite. In many places, the dunites form single veins or pods, but here they form a series of criss-crossing anastomosing veins up to 3 m in thickness. The veins are composed of serpentinized olivine and, in many places, small stringers of chromite and *schlieren* of partly digested peridotite. The margins of the veins are not sharp, but diffuse and gradational over a distance of 1–2 cm, with the prominent orthopyroxenes of the peridotite decreasing in abundance into the vein. These features suggest that this is a high-temperature phenomenon with wall-rock reaction involved.

Interpretation

The cliffs along the west side of Lankidden show with great clarity the effects of high-temperature shearing deformation of various intensities in a coarse-grained gabbro, producing intense banding and augening. This was recognized long ago by Teall (1888) and is the best example in southwest England, and possibly the whole of the UK.

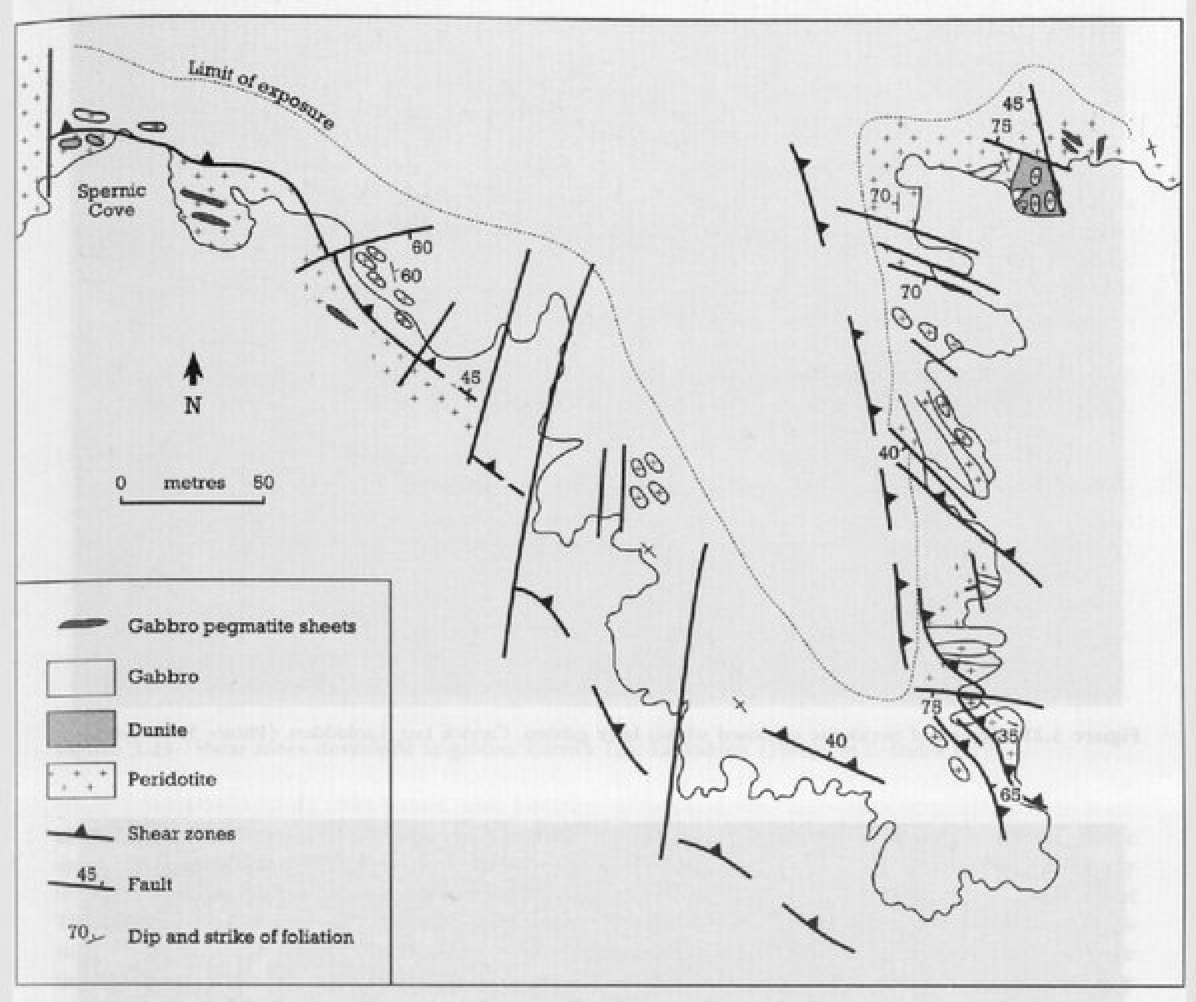
The dunite veins are of considerable interest, even though their origin has yet to be definitely established. Flett and Hill (1912) suggested they were formed from a separate 'chromite serpentine' magma, distinct from the bastite serpentine (primary peridotite). Green (1964a), however, thought they were just the result of extreme serpentinization of the primary peridotite. It is the author's view that they are a high-temperature phenomenon, as outlined above, and that they were possibly the pathways of picritic melts ascending through the hot upper mantle. As the melts passed up through the mantle, they crystallized olivine, and the heat of crystallization — and possibly some fluid from the magma — was sufficient to cause local partial melting of the wall rock which was already close to its solidus. This caused the melting of pyroxenes: the lowest-melting fraction in the peridotite, and produced the diffuse margins that may now be observed. Whatever their origin, these dunites are a significant feature of the Lizard peridotite, and this is the best exposure.

The outcrops around Lankidden give superb examples of many phenomena of interest to both igneous petrologists and structural geologists. They are of relevance to studies of Lizard geology and of geological phenomena in general. Such is the clarity of these features, that their interpretation has changed little during the last 100 years.

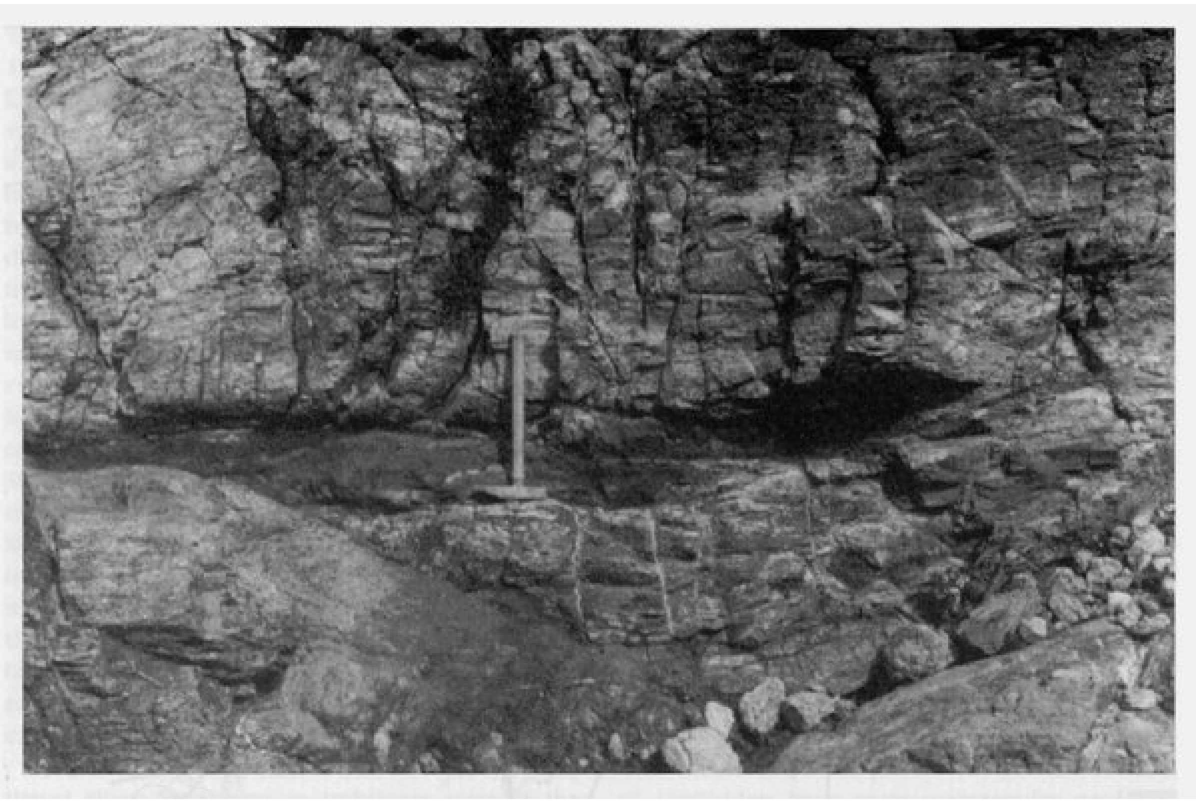
Conclusions

The outcrops here are composed of sheared gabbros and altered peridotites of the Lizard Complex. The gabbros are demonstrably younger than the peridotite, and contain included fragments of the latter. The sheet-like gabbro body has suffered deformation at high temperatures, such that it is heavily sheared, with the development of intense banded texture with augen (German, meaning literally 'eyes') – large remnant crystals set in a finer crushed matrix. Dunite (an olivine–rich peridotite) occurs as veins and represents mantle-derived ultramafic melts which solidified within the peridotite host rock.

References



(Figure 3.20) Geological sketch map of the Lankidden site (A8) showing distribution of outcrops between landward exposures and low-water reefs.



(Figure 3.21) Lenses of peridotite enclosed within later gabbro, Carrick Luz, Lankidden. (Photo: M.T. Styles.)

(Figure 3.22) Flaser gabbro, Carrick Luz, Lankidden. (Photo: M.T. Styles.)

(Figure 3.23) Shear zones developed in gabbro, Carrick Luz, Lankidden. (Photo: M.T. Styles.)