TROODOS – FROM SEA TO SUMMIT

by Dr Ron Dutton, 2002

(Sadly, this book was 'borrowed' and never returned, so the opening 6 chapters are no longer available.)

CHAPTER 7 - TROODOS

Troodos is truly the 'Big Country' of Cyprus and far removed from its fringe of sand, sea and concrete. It's a good idea to take a good look at the mountain while still crossing the limestone plateaux from where its stands out in majestic splendour against the sky. Once among its forests, valleys and sharply rising ridges, it's hard to see beyond the next bend in the road and it pays you not to try.

Before looking in detail at this, the ultimate section of our sea-summit journey, it seems appropriate to recap what we know so far. In Chapter 2 we saw that the world's ocean floors are created and recycled by the processes of seafloor spreading and subduction (Fig 2.2). Through fissures along active spreading ridges, magma from the Earth's Upper Mantle escapes intermittently as molten basalt lava unto the ocean floor. There, despite its high temperature, the lava is quickly chilled by contact with seawater and flows only short distances before cooling, piling up and welding itself to the ocean crust in rounded masses called pillow lavas. Much of the rising magma in fact never reaches the ocean. Some cools within crustal fractures as vertical sheets of intrusive diabase lava. Making up the rest of the ocean crust at deeper levels still are plutonic rocks such as gabbro, under which lie rocks from Upper Mantle peridotite magmas. (Figures 1.1 & 3.3).

Take a downward slice through ocean crust and the levels expected would be as follows:

1. Ocean floor sediments accumulated over pillow lavas.

2. Extrusive pillow lavas from past active seafloor spreading.

3. Intrusive dykes of lava, filling fissures close to the spreading zone

4. Plutonic rocks from mantle magma chambers and fissures

5. Mantle rocks derived from slow cooling peridotite magmas

Troodos, along with other ophiolites, is regarded as being a chunk of such oceanic crust, fortuitously raised high and dry for geologists and 'rock hounds' to explore. This being so, we would expect it to have that same sequence of rocks in the same order. As it is, uplift of the ophiolite has caused its deepest rocks to be thrust through overlying levels, giving the exposed sequence in reverse order. Thus Level 5 is now the highest, having been forced through other rock groups that encircle it as remnants of a once complete cover.

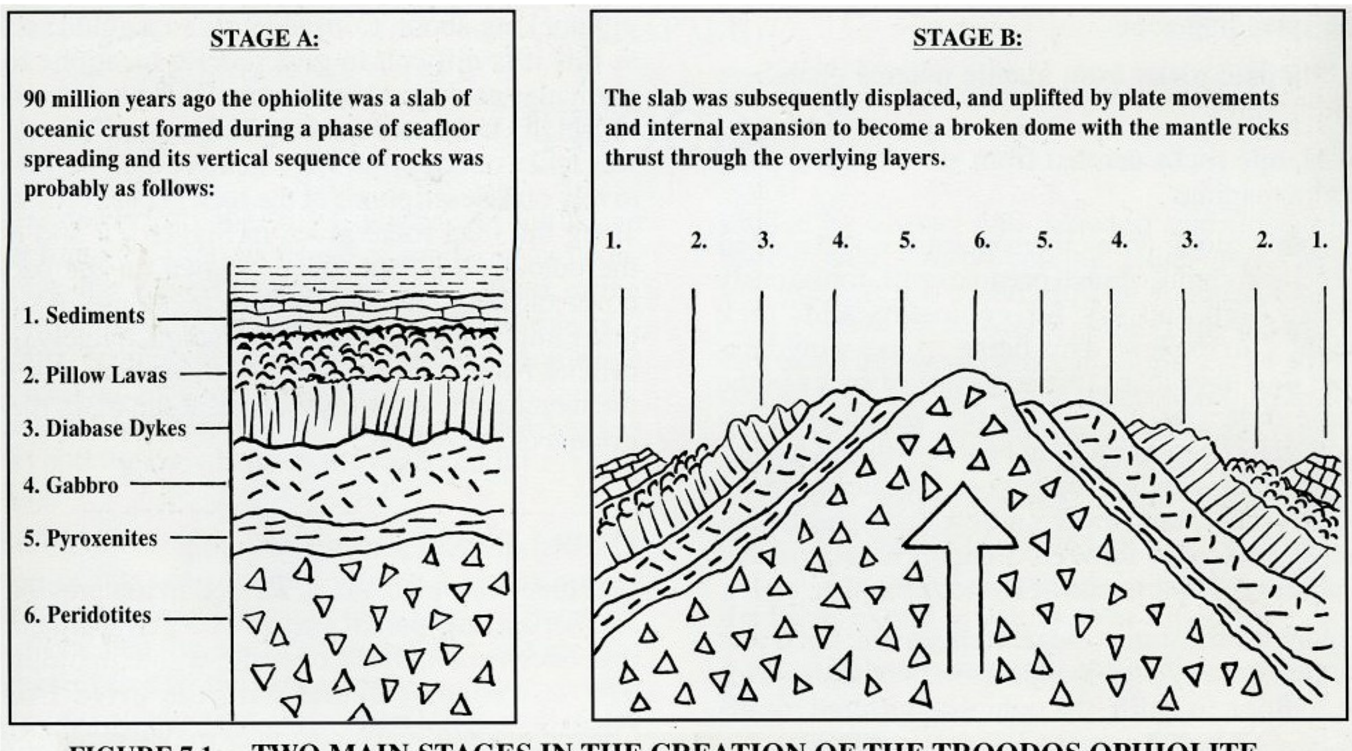
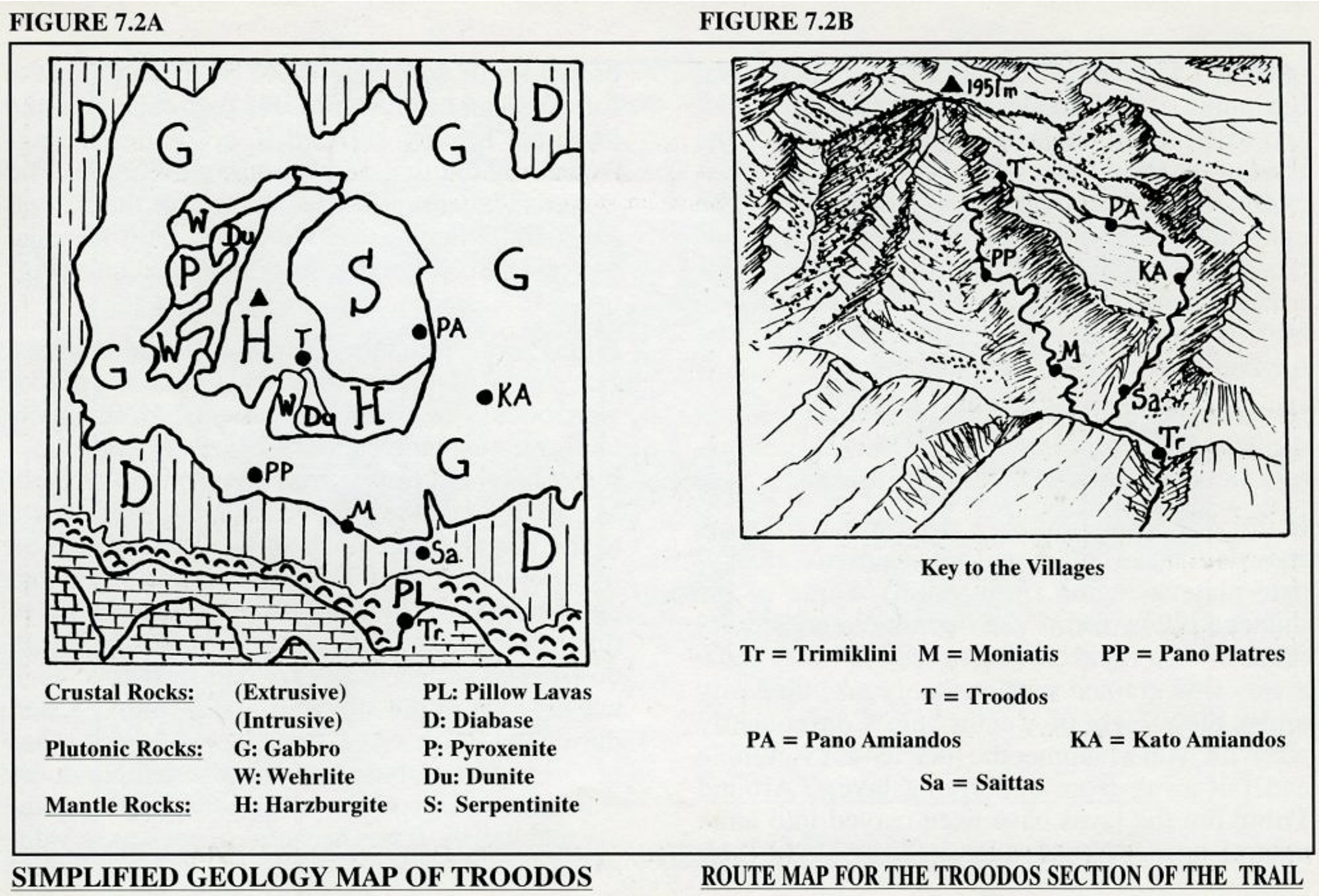


FIGURE 7.1 TWO MAIN STAGES IN THE CREATION OF THE TROODOS OPHIOLITE

Figure 7.1 illustrates the rearrangement, but it was far less orderly than it appears in the diagram, for in addition to uplift, the ophiolite suffered the effects of internal chemical alterations, intrusions, faulting and displacements. The result is that while geologists regard Troodos as being one of the best preserved of ophiolites, it has still undergone a lot of knocking about. Consequently in a guide such as this it is difficult to give precise locations for particular geological exposures. This has become especially true since the 1:50,000 map of Troodos was taken out of print. Here in this guide we have to rely on a description for the rock groups crossed along the road route given in Figure 7.2. We can also make use of one other important source of information, namely the official Nature Trails. More of those later, but in the meanwhile let us take a look at the main rock groups of the region.



Pillow Lavas

The limestone plateaux described in the previous chapter are only part of a cover of ocean sediments that once accumulated over the whole ophiolite. The last chapter ended with the drive from Perapedhi on the E802 to the junction with the B8 Limassol-Troodos road a little north of Trimiklini village. Along the way, the white chalks and limestones of the plateau scarp give way to outcrops of brown, bulbous pillow lavas that mark the real beginning of the Troodos ophiolite (Figures 4.3A and 4.3B). Here on the south side of Troodos the zone of the lavas is very narrow. Elsewhere, especially on the eastern and northern flanks of the ophiolite, there are better and more extensive outcrops. For example, along most of the way between junctions 8 and 12 of the Limassol-Nicosia highway their distinctive ‘pillow’ forms can be seen on either side of the road.

Nevertheless enough of the lavas can be seen in the Trimiklini area to get some idea of their nature and their influence on the landscape.

In this particular zone their dark brown colour is enough to make them stand out against the chalky-pale plateau region (Figure 7.3). Some of the rounded pillow forms can be quite large and because of their rapid cooling in seawater they show a very fine grained surface that breaks up easily under the effects of weathering. Consequently when hit with a hammer the rock tends to crumble and fall away from underlying layers. Around Trimiklini the lavas have been carved into large natural terraces by the River Kouris and their brown fertile soils kept moist by irrigation make for excellent cropland. In this particular area the lavas are heavily *brecciated*, crushed and fragmented by faulting during earth movements. The ‘Fractis Restaurant’ at the junction of the B8 and E801-E802 is close beside a dam built to make use of a narrow gorge in the brecciated lava (Figure 7.4).

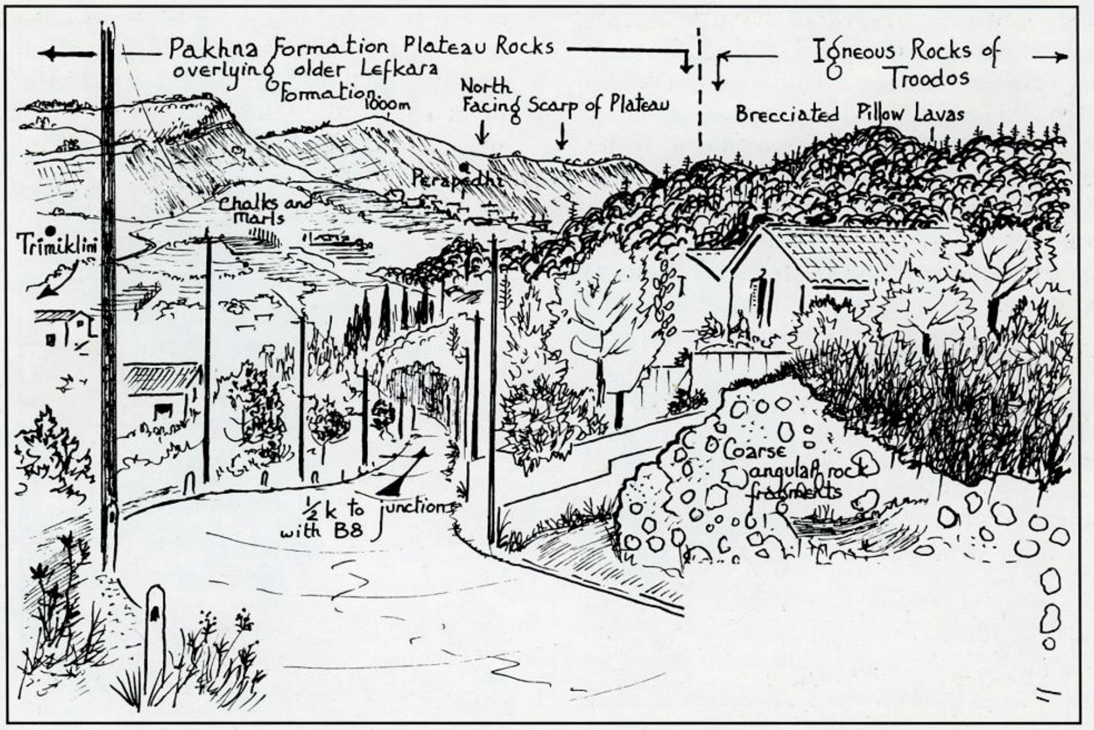


FIGURE 7.3 FACING WEST TO PERAPEDHI FROM THE ROAD TO PELENDRI AND AYIOS MAMAS

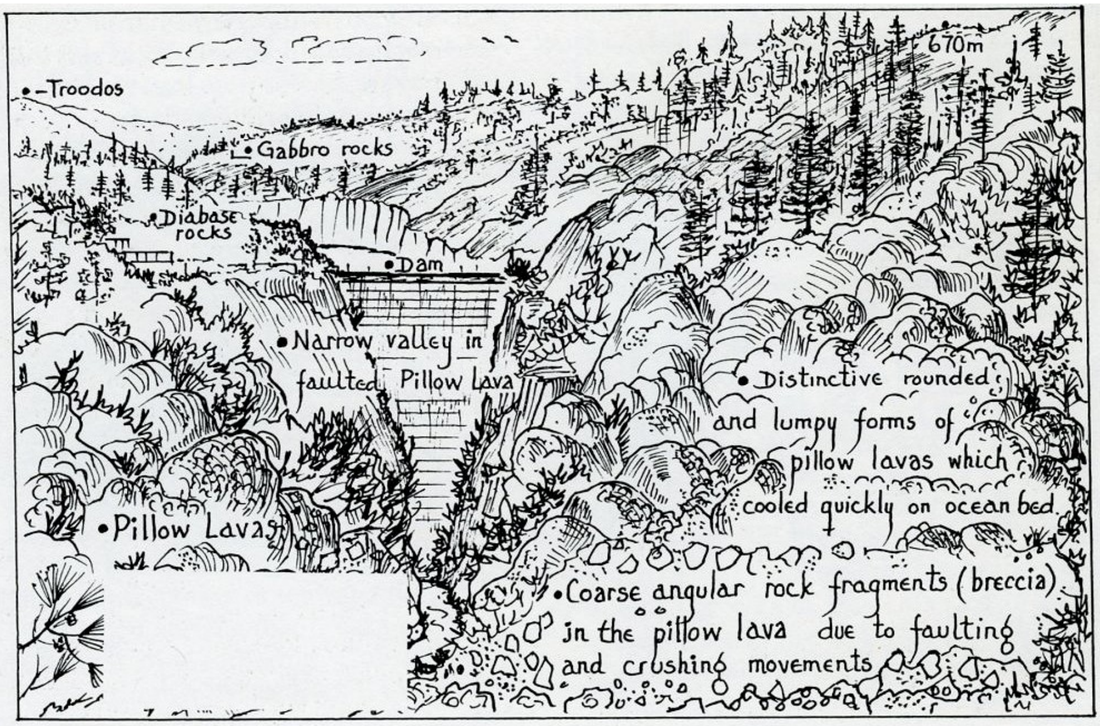


FIGURE 7.4 PILLOW LAVAS BELOW THE DAM AT TRIMIKLINI

Pillow lavas from other fringes of Troodos were a rich source of mineral deposits. Ochre and umber were both valued as paint pigments. More importantly, almost pure bands of silvery or gold-looking copper and iron pyrites were mined as early as 3000BC and their export brought great wealth to the island. Some of the ores were smelted on the spot in primitive furnaces burning wood and charcoal and the great extent of the activity led to much of the island's natural forest cover being cut down. The copper was exported in ingots, each usually cast in the shape of a sheepskin. Later, during the Bronze Age, trade increased and relics of the period include huge bronze temple doors from sites in Egypt, as well as nails, knives, coinage and statues. It was because copper was so valuable that the Romans took possession of the island, and the remains of their baskets, ropes and wooden props have been found in old mine shafts here.

For anyone particularly interested in pillow lavas and their associated minerals, it is worth making a visit to the two old copper mines of Sha and Mathiati, off the Limassol-Nicosia highway. They are only 6 km apart and some attractive rock and mineral specimens can still be found in their spoil heaps.

The Diabase

All but the first 100-200m of the B8 road from the Trimiklini junction to Moniatis lies across the zone of diabase dykes encircling Troodos (Figures 7.2A and 7.2B). This particular section of the ring is narrow, but in total area the so-called ‘Diabase Group’ accounts for the greater part of the Troodos Range and its extent gives an idea of the scale of intrusive activity during the active phases of seafloor spreading.

Unlike *extrusive* pillow lava, diabase is a fine-grained *intrusive* rock derived from lava that never quite reached the ocean floor. Instead it filled tension fractures already opened on either side of a seafloor-spreading ridge. The result is that it outcrops in closely packed *dykes* or slabs, steeply tipped on edge. Because the fractures varied in thickness and length, the same is true of the lava dykes. Moreover some were altered by invasions of seawater while still cooling, so the rock, though basically hard, differs to some extent in composition and resistance to weathering. This differential response to weathering and erosion gives rise to a landscape that is typically irregular and craggy. (Fig 7.5).

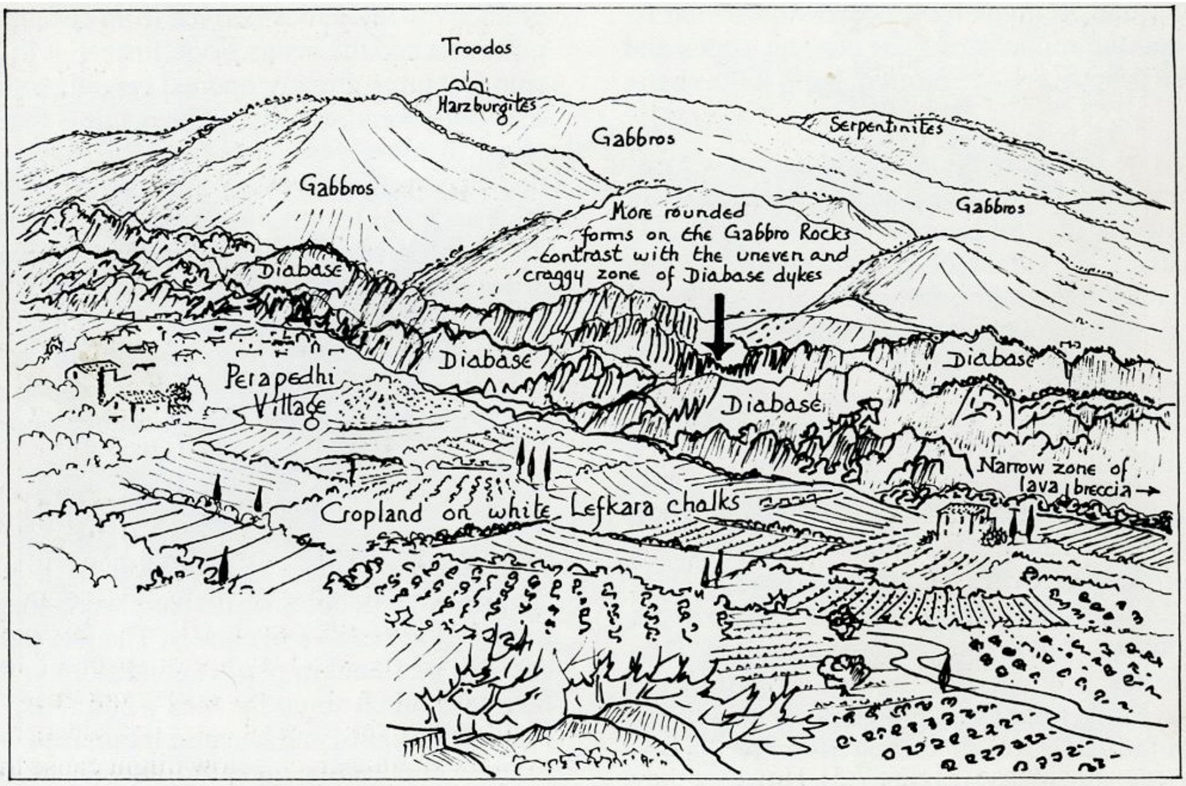


FIGURE 7.5 **FACING TROODOS FROM THE KOUKA-PERAPEDHI ROAD**

In Neolithic Cyprus (8,200-3,900 BC), suitably shaped river pebbles of diabase were sharpened to make axe heads and chisels. The fact that these can still be found in perfect condition on the surface says much about the rock’s hardness. Today because it is hard and because it outcrops in well-jointed and easily quarried sheets, diabase is widely used in Cyprus for road metalling.

The Gabbro Zone

From Moniatis to Pano Platres and beyond to Troodos village, the main rock is gabbro, with some pyroxenites. Although now higher in altitude we have moved deeper into the ophiolite, further from the old ocean floor and closer to the interior.

Although not unlike diabase in appearance, and sharing the same magma origins, gabbro is darker grey in colour with slightly coarser crystals because of slower cooling. Three of its most visible minerals are feldspar (white), augite (black) and olivine (green). However, the composition of the rock varies to give several different types including uralite gabbro, olivine gabbro and pyroxenetic gabbro. The rock represents the most extensive part of the ophiolite’s plutonic rocks and comes from magma that cooled slowly in deep chambers to give a coarse mush of crystals.

Although still rugged, the mountain profiles on gabbro rock are generally more rounded and less craggy than on diabase (Figure 7.5). However they do show signs of massive crushing by past earth movements, which together with the high winter rates of freeze-thaw weathering today, have given rise to long scree slopes of shattered rock.

Core Rocks of the Ophiolite

Beyond Platres the road gradients are steeper ; the great domed mass of Troodos become more obvious. Within 2 km of Troodos village we reach the core of the ophiolite. Stand anywhere in Troodos Square and pause for a moment to reflect on the fact that the rocks under your feet are from below the floor of the Tethys Ocean.

We are now among rocks rich in combinations of olivine and pyroxenes and referred to generally as *ultramafics*. Unlike other rocks encountered so far on our trail, these are all thought to be derivatives from ‘parent magma’ in Earth’s Upper Mantle and for that reason they are of special interest to geologists. For our purposes it’s not necessary to grapple with the mineral complexes involved, and even the outline given below might cause the eyes to glaze over, but the diagram in Figure 7.6 should help to show how the rocks are related.

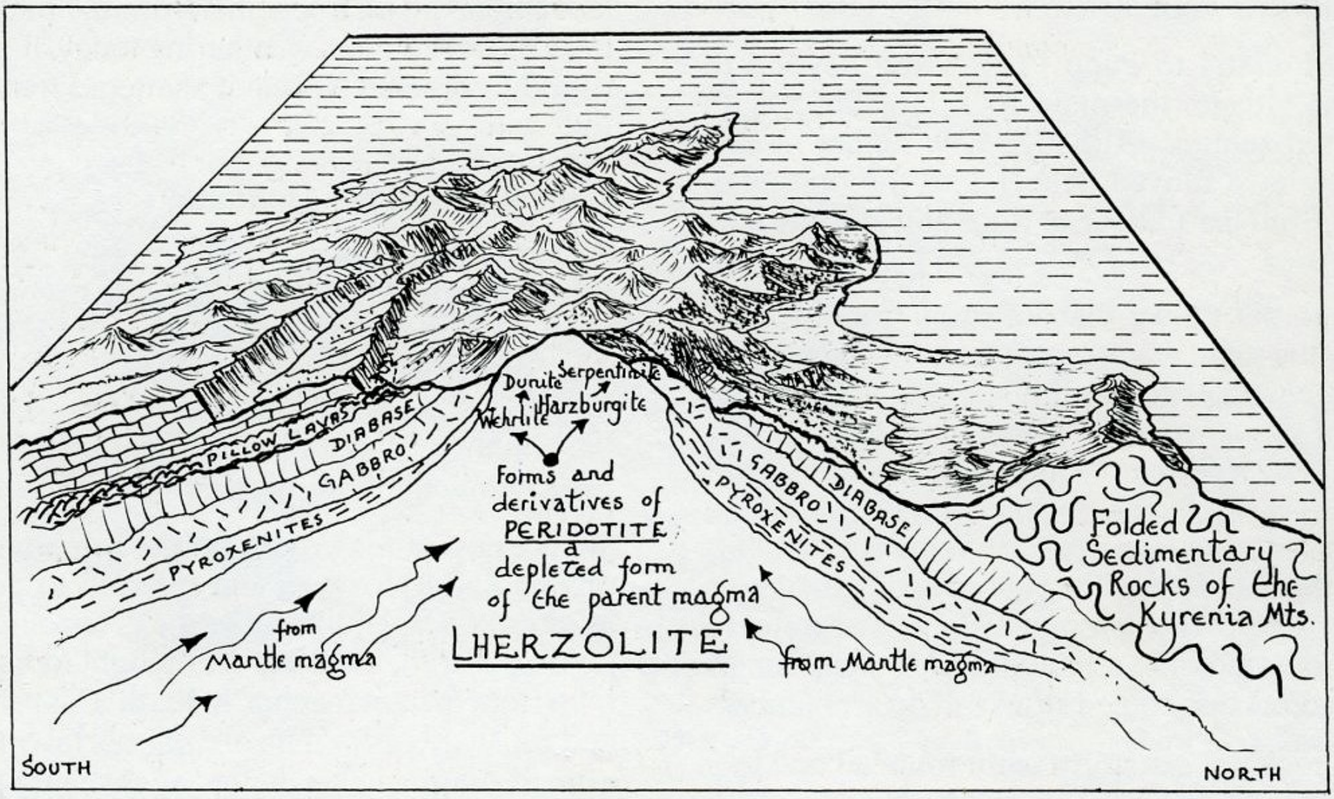


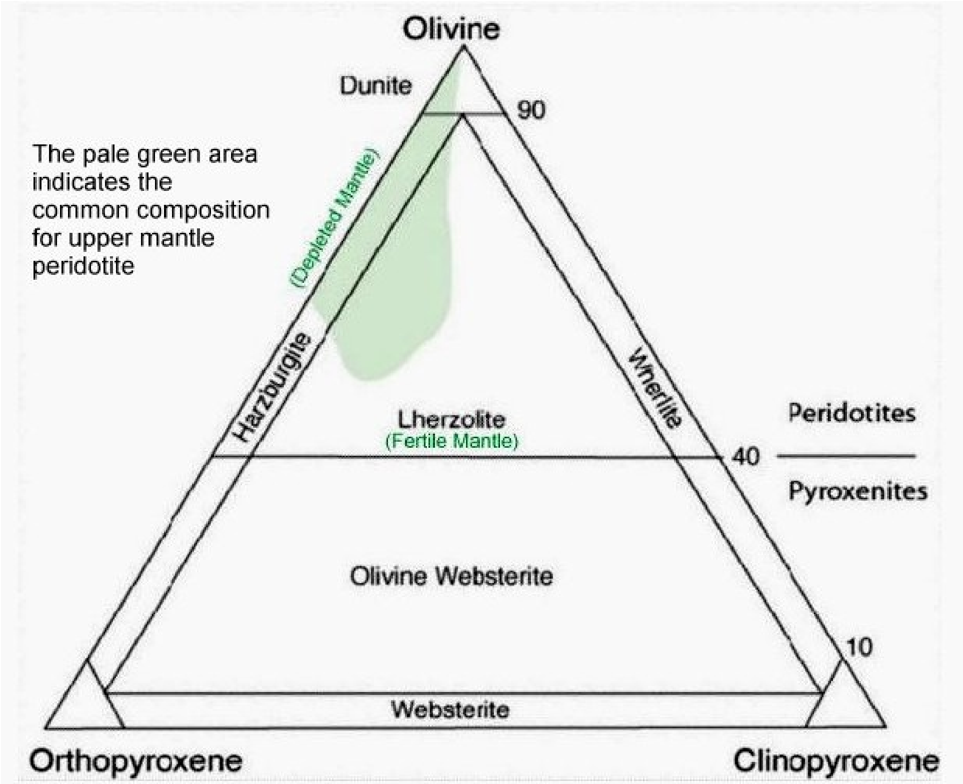
FIGURE 7.6 **SOUTH TO NORTH SECTION THROUGH TROODOS TO SHOW MANTLE ROCKS OF THE OPHIOLITE**

Basically, *harzburgite* and *wehrlite* are both *peridotites*, depleted forms of *lherzolite*, which in turn is thought to be the ‘fertile’ parent magma of the Upper Mantle. The peridotites represent residues left behind by the rise of less dense basaltic magma to higher levels. Harzburgite has a high percentage of *olivine* and this has had an important consequence because olivine is a mineral that readily absorbs water. Where the harzburgite was subjected to penetrations of seawater the olivine content was converted to the mineral *serpentine*. Figure 7.6 therefore shows serpentinite rock to be derived from parent harzburgite. The hydrothermal processes that brought about the alteration had two further outcomes:

(a) hydration of the olivine induced heating and expansion that contributed to uplift of the whole ophiolite,

(b) veins of *chrysotile asbestos* were left by steam passing through much of the original harzburgite.

The asbestos content in serpentinite led to extensive quarrying, the effects of which can be seen along the B9 road from Troodos to Pano Amiandos (Figures 4.4 and 7.2). Even fragments picked up from roadside screes of the shiny green rock show thin veins of the asbestos, the threads of which are strong, extremely light, and as everyone knows, don’t burn. Held under a flame, a thread of asbestos will glow but it won’t catch fire and for that reason the Romans used it for lamp wicks. With the modern use of asbestos for fire resistant clothing and building-fabric, large scale quarrying of the serpentinite went on at Pano Amiandos throughout most of the 20th century until asbestos became generally recognised as a serious health hazard. The workings have now ceased but the abandoned quarries remain as landscape features Troodos could well do without.



Dunite, another of the peridotite group, is practically a one-mineral rock that is composed almost entirely of olivine. It occurs in concentrations towards the top of the harzburgite and it weathers to give distinctive brick-red exposures dominating large areas of upper Troodos. Dunite too became economically important wherever it was found to contain veins or lenses of black and heavy *chromite*. Mining ceased in the 1970's but abandoned mine buildings remain about 2 km north of Olympus. Access to these is poor and the site is barely worth a visit except perhaps as a hunting ground for specimens. The most attractive variety, known as 'leopard ore' has spots of black chromite in a matrix of reddish brown dunite or green serpentinite.

Diabase... gabbro... serpentinite... harzburgite... peridotite... and the others. They can be very confusing and difficult to differentiate in the field. Moreover, because of changes brought about by weathering, their outside surfaces can look very different to what lies inside. This is especially true for dunite, the brick-red surface of which is only a weathered skin over a rock that on the inside can vary from dark brown to grey-black. However, the colour photo on the back cover of the book should help the reader to recognise virtually all the rocks mentioned throughout the Sea-Summit trail. Moreover, for the rocks of the Troodos region, further help is at hand... The Cyprus Tourist Organisation (CTO) and Forestry Department have established more than forty Nature Trails, four of which are centred on Troodos. To walk even one of those trails is to enter a peaceful forest world totally different from the Cyprus shoreline of sea and sand. A stay of two or three days in the mountains gives time to walk one or more of the trails, all of which bear numbered and labelled markers to features of interest including trees, shrubs and... yes... rocks. Harzburgite, dunite, chromite, pyroxenite, wehrlite, gabbro and diabase are all identified at points among the four Troodos trails.

Needless to say, the Forestry Department has its work cut out to maintain the trails in good order without them being looted by enthusiastic 'rock hounds'. Therefore the familiar instruction to 'Look with your eyes and not your hands' applies to the trail-trekkers. So too does the eco-watchword, 'Take only photos and leave only footprints'. However, having seen the rocks at first hand and having this book as a guide should make it easier to collect specimens from less fragile settings away from the trails.

A foldout sheet covering all the Cyprus Nature Trails is available free from offices of the CTO and the sheet has small maps showing the regional location of the eight groups of trails. Unfortunately it gives no detailed descriptions of the trails themselves or of their labelled points of interest. For that reason Table 3 offers some detail for the Troodos trail points that refer to geology.

The End of Our Trail

At this point we come to the end of our own particular trail. However, although the book has ended, the Troodos geological wonder is still out there, as it has been for millions of years, waiting to be explored...

Enjoy!