Uplands of Ultrabasic Rocks

If one continental region can underthrust another (as proposed to account for the double crustal thickness of Tibet) and if the oceanic floor and continental borderlands can underthrust the continents (as proposed for the North American Cordillera), then one might reasonably expect to find examples where, by some local tectonic 'accident', the oceanic floor has ridden over the adjoining continental crust instead of gliding beneath it. Alternatively, such relative movement could be described by saying that an advancing continental crust had locally 'plunged' into the upper mantle beneath an oceanic crust, instead of riding over the latter. In such an event the basic and ultrabasic rocks would be upheaved by the buoyant effect of the underlying sial and, if the sial were sufficiently thick, they would emerge as land with a thin veneer of oceanic sediments. The latter, followed by the basic rocks, would soon be removed by erosion from the rising upwarp, and eventually there would be a growing area of land consisting of heaved up rocks which were originally part of the mantle. Such rocks would probably be peridotites and their associates. The southern part of Cyprus is one example of this kind for which there is good supporting evidence, and others will probably be added in due course, e.g. in New Caledonia, where thousands of square miles are underlain by ultrabasic rocks of great thickness.

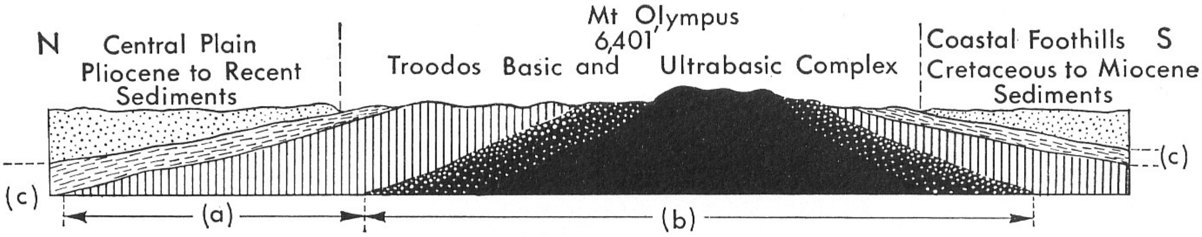

FIG. 800 Diagrammatic section through the Troodos Massif, Cyprus, showing (a) the Sheeted intrusive complex ; (b) the Troodos plutonic complex : ultrabasic rocks, black ; marginal basic rocks, black with white dots ; (c) the Pillow Lava series. Length of section 38 miles (60 km). *(After I. G. Gass and D. Masson-Smith, 1963)*

Cyprus has two E-W mountain ranges separated by a central plain. The northern range is part of an Alpine orogenic belt: a link, so to speak, between southern Turkey and Syria. The southern, Troodos range is a vast igneous massif of basic and ultrabasic rocks, made up of three main units, as indicated in Fig. 800.

(a) The oldest unit, known as the Sheeted intrusive complex, consists of a swarm of N-S basic dykes invading a series of spilitic lavas, including pillow lavas. The dykes make up over 90 per cent of the whole and, being nearly vertical, their total thickness implies that during their intrusion the area was extended 80 miles or more in an E-W direction. The near-vertical 'sheeted' structure resulting from the close packing of the dykes recalls the structures of the NE Pacific floor illustrated on p. 940.

(b) The central part of the massif (Fig. 801), called the Troodos plutonic complex, consists of a variety of ultrabasic rocks, veined by gabbro, which becomes the dominant type towards the margins, where it is locally accompanied by granophyre veins.

(c) The third main unit, the Troodos pillow lava series, is a thick sequence of pillow lavas, with associated sills and dykes, which now form a rim surrounding (a), as a result of the elliptical dome-like structure of the whole massif. The marine sediments overlying the pillow lavas locally begin with early Triassic strata, and as the lavas rest unconformably on (a) and (b), a late Palaeozoic age is the latest that can be assigned to the Troodos massif as a whole.

Since the early years of the century it has been difficult to reconcile the geomorphological evidence that Cyprus is an area of present-day uplift with the geological evidence that the 1,000 square miles of the Troodos range are underlain by rocks of abnormally high density. Downwarping would be expected, not uplift. Later investigations only intensified the difficulty. The first gravity measurements, carried out in 1939, added to the puzzle by showing that the whole island was the site of strong positive anomalies, and that the large surplus of mass so disclosed was greatest along the Troodos range. Later it was found that the range had been uplifted at least 10,000 feet since the Cretaceous, while the rest of the island had risen only 3,000 feet or less, much of it having been under the sea during the Tertiary.

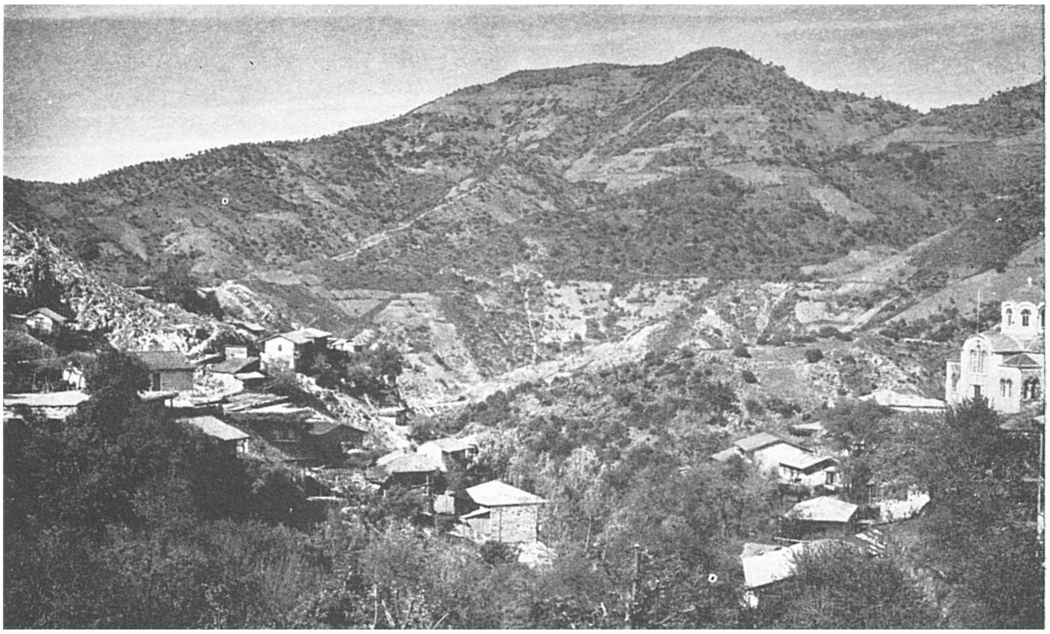

FIG. 801 The crest of the Troodos Massif, Cyprus, looking south from the village of Moutoullos, which is situated where the marginal gabbro begins. The range beyond is peridotite. *(By courtesy of British European Airways)*

In their record (1963) of the latest gravity survey, I. G. Gass and D. Masson-Smith show that the distribution of the positive anomalies implies that the thickness of high-density rock (such as peridotite) must be at least 7 miles under Mount Olympus and at least 20 miles under the NW end of the Troodos range. Corresponding to this contrast they find that the anomaly around Mount Olympus falls to about half the average for the range, and is even lower over the summit. This secondary anomaly within the major anomaly points unmistakably to the presence of a thick layer of light rocks, such as sialic crustal rocks, beneath the slab of Troodos ultrabasic rocks. This suggests that the 'slab was once part of the upper mantle underlying an oceanic area between the African and Eurasian continents.'

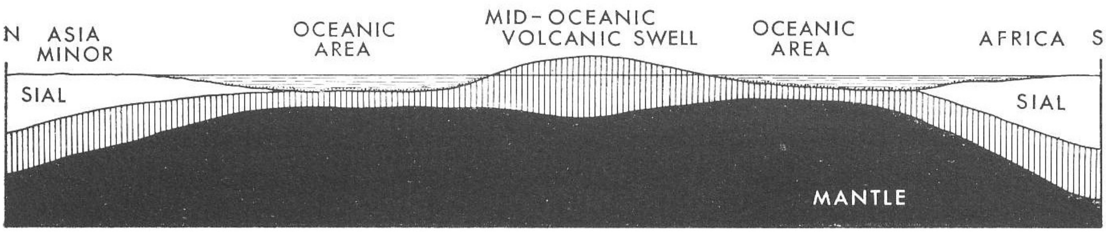

FIG. 802 Diagram to illustrate an early stage in the development of the Troodos Massif : the formation of the Sheeted intrusive complex, as a volcanic swell in the oceanic area of the Tethys, which then lay between Africa and Eurasia. *(After I. G. Gass and D. Masson-Smith)*

Developing an idea first put forward by D. W. Bishopp, that the Troodos massif might represent an immense volcanic pile that originated within the oceanic part of the Tethys (Fig. 802) at a time when the bordering continents were much farther apart, Gass and Masson-Smith suggest that 'when the continental shields approached each other during the Alpine orogeny this slab of mantle was underthrust by the edge of the African shield and thereby raised to its present level in the upper part of the crust' (Fig. 803).

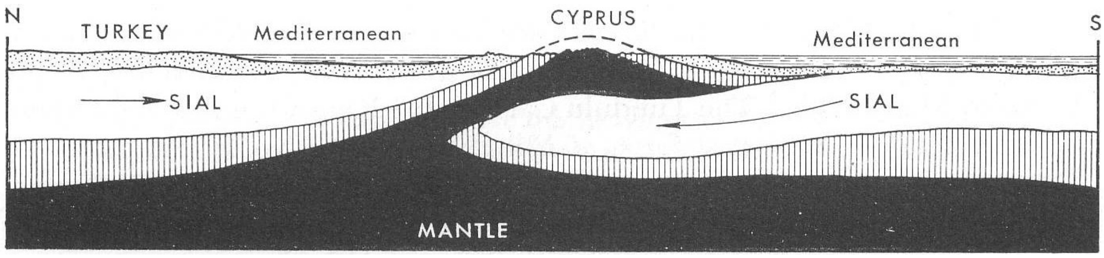

FIG. 803 Diagram to illustrate a later stage in the development of the Troodos Massif : with the approach of Africa and Eurasia the African crust has underthrust the Cyprus area, heaving up the ultrabasic and related rocks of the mantle. *(After 1. G. Gass and D. Masson-Smith)*

GASS, I. G. and MASSON-SMITH, D., 1963, 'The Geology and Gravity Anomalies of the Troodos Massif, Cyprus', *Philosophical Transactions of the Royal Society of London, A,* vol. 255, pp. 417-67