Ardtun

Highlights

The lacustrine sedimentary deposits between the Palaeocene lavas contain leaves of temperate plant species. The sediments and plants make up the renowned Ardtun Leaf Beds which are the prime interest of this site and are of international importance. The underlying lava contains pillows and was erupted into a shallow lake.

Introduction

The coastal cliffs and gullies within this site provide internationally important exposures of sedimentary deposits within the basal lavas of the Plateau Group in south-west Mull. These sediments are fluvial sands and gravels, which contain the renowned Ardtun Leaf Beds of important palaeobotanical value, are the prime interest of the site.

The sediments were originally discovered by a local man from Bunessan but were first fully investigated by the Duke of Argyll (1851). The discovery was of major importance in the study of the volcanic rocks of Mull since the sediments contained a rich terrestrial fossil flora and therefore allowed the associated lavas to be relatively dated. A full history of research, including a comprehensive list of the extracted plants, is given by Seward and Holttum in the Mull Memoir (Bailey *et al.,* 1924). In addition, a full description of the site is provided in a field excursion guide to the Tertiary volcanic rocks of Mull by Skelhorn (1969). Radiometric age studies on the lavas above and below the leaf beds have been carried out by Evans (1969), Mussett *et al.* (1973) and Mussett (1986).

Description

Although exposure is almost continuous along the coastal cliffs, the most accessible sections are located within small gullies leading down the cliffs (Figure 5.6) and (Figure 5.7). A sedimentary succession, which varies in thickness between 4 m and 15 m, lies upon the upper slaggy amygdaloidal zone of a thick columnar lava flow which exhibit well-developed, twisting columnar joints in the cliffs and sea stacks. Above the sediments, a second major columnar lava flow is exposed. Both lavas are olivine basalts of the Staffa Magma Type (Thompson *et al.,* 1986), or Group 2 of Beckinsale *et al.* (1978), (Table 5.2). The best section through the sediments is to be found in the ravine at Slochd an Uruisge [NM 377 248] and is described in detail by Skelhorn (1969). The sediments are predominantly flint-bearing conglomerates and grits, but contain three finer-grained horizons of silty sandstone and clay. The latter are known as the Ardtun Leaf Beds (Top, Middle and Bottom), containing an abundant leaf flora, including remains attributed to *Platanus* (plane), *Corylus* (hazel), *Quercus* (oak) and *Ginkgo* (maidenhair tree) (Skelhorn, 1969). The specimens are exceptionally well preserved and some are thirty or more centimetres in length, although they are extremely fragile. In addition, a sparse molluscan fauna has been recorded (Cooper, 1979) and fragments of a terrestrial beetle *Carabites scoticus,* a possible weevil and a ceropid insect have also been identified (Gardner, 1887; Cockerill, *in* Bailey *et al.,* 1924). The lowest leaf bed is underlain by a thin coal seam which passes down into 0.15–0.20-m-thick, whitish, concretionary root clay on top of the lower basalt flow (Bailey *et al.,* 1924).

The coarser-grained sediments are rich in angular quartz grains and derived flints and silicified chalk pebbles are abundant in the conglomerate. Pebbles of porphyritic igneous rocks are also present which may be of Palaeocene age and derived from nearby flows, or of Lower Old Red Sandstone age (Bailey *et al.,* 1924); conclusive evidence for their source is lacking.

The gullies to the east of the main locality [NM 377 248] expose a dolerite sill transgressive towards the lavas and the intercalated sediments. Against the sediments, the sill has a well-developed tachylitic margin which has partly devitrified. The flow beneath the sediments contains pillows which may be either whole or fragmented, probably formed when the lava flowed into a small, temporary lake (Skelhorn, 1969).

A little to the south-east of Eilean an Duilisg [NM 386 249], the sedimentary horizon is downthrown below sea level by a N–S-trending fault.

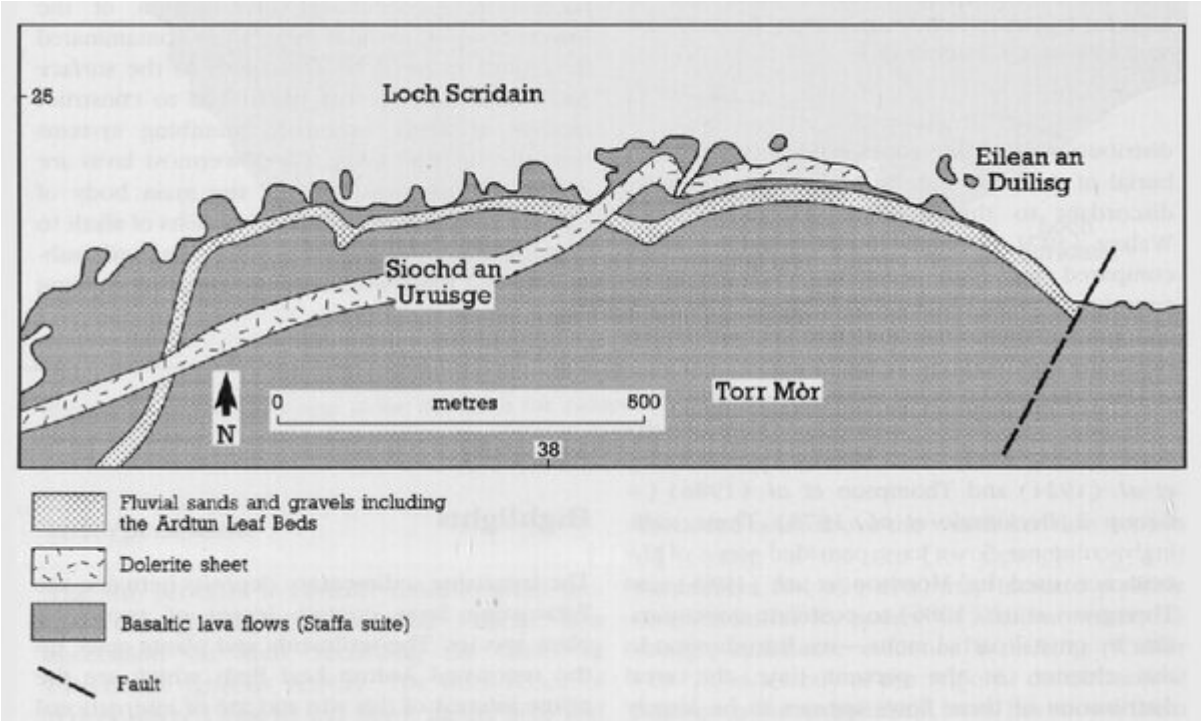
Interpretation

These deposits provide valuable evidence for extended periods of sedimentation during the period of lava effusion in south-west Mull. The sediments and associated flora indicate deposition in a shallow temporary lake surrounded by marshland and which intermittently received sediment and plant debris from surrounding areas. Lava occasionally flowed into this wet environment, resulting in the development of pillow structures such as those immediately beneath the sediments. The flora in the sediments shows that a temperate climate prevailed. These conditions were established on a land surface created by the first large Palaeocene lava fields in this region. Coarse, clastic sediments were probably derived from the surrounding volcanic landscape and possibly from the tuffs containing pebbles of Cretaceous flint exposed near Malcolm's Point, Carsaig (Skelhorn, 1969). The finer-grained Leaf Beds may represent deposits formed during periods of stagnation when little sediment was washed into the lake and a limited freshwater fauna flourished. The plant material in the Leaf Beds has been correlated with other temperate northern floras and dated as early Eocene (Gardner, 1887; Seward and Holtum, *in* Bailey *et al.,* 1924), although their age is now generally accepted as being Palaeocene (but see Simpson, 1961). In addition, radiometric dates for the lavas above and below the Leaf Beds reveal an age of around 58 Ma (Evans, 1969; Mussett *et al.,* 1973, 1980). A geochemical discussion of these lavas is presented in the 'Introduction' to this chapter.

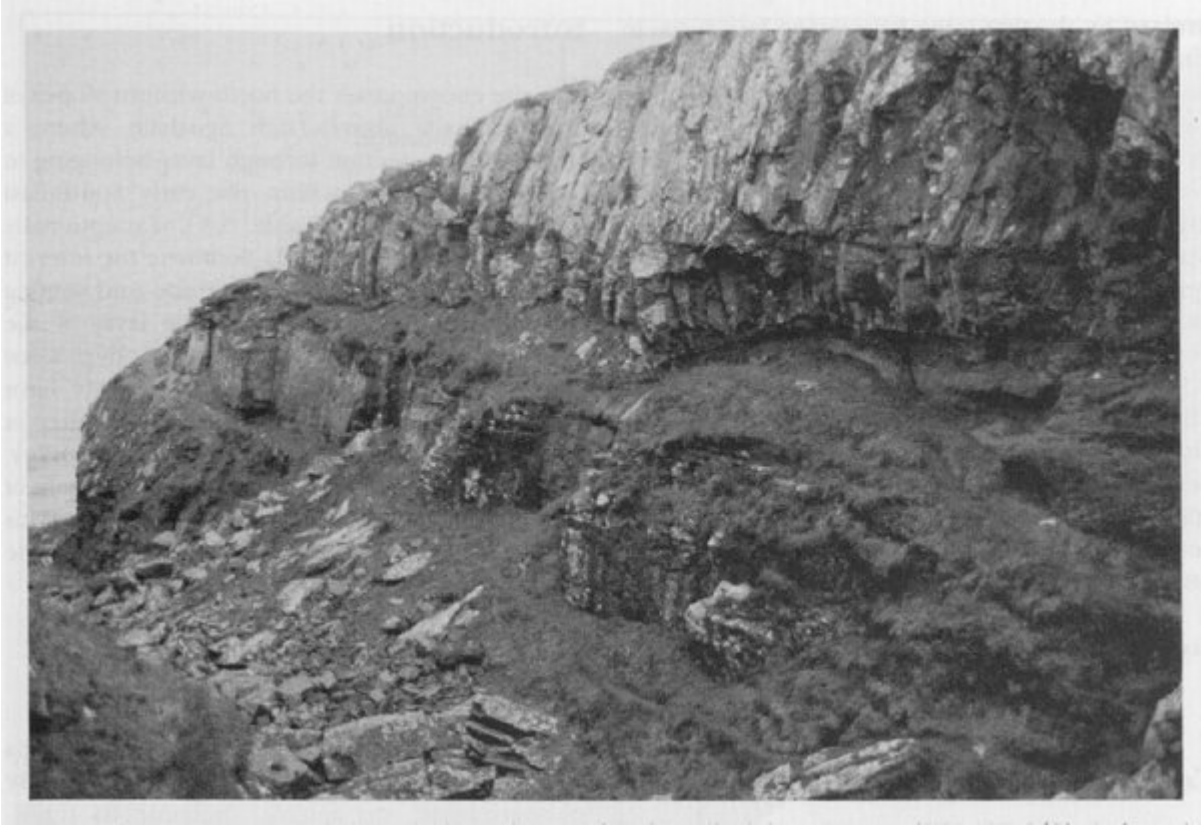
Conclusions

The rich, well-preserved flora includes temperate-climate tree species such as plane, hazel, oak and ginkgo. They were preserved during relatively quiet periods of sedimentation when muds and silts accumulated; at other times, when more vigorous sedimentation gave sands and gravels, the delicate plant debris was probably destroyed. The coarser-grained debris was largely derived from the surrounding volcanic landscape but the presence of fragments of Cretaceous flint and silicified Chalk may indicate that older rocks may also have been exposed to erosion. The sediments were laid down in shallow lakes, or from rivers flowing across the lavas; the basaltic flow underlying the plant-bearing sediments was probably erupted.

References



(Figure 5.6) Geological map of the Ardtun site (adapted from the British Geological Survey 'One Inch' map, Sheet 43, Iona).



(Figure 5.7) The best section through the Ardtun Leaf Beds at Slochd, an Uruisge [NM 377 248]. Ardtun site, Mull. (Photo: C.J. MacFadyen.)

Mull Memoir (Bailey *et al.*, 1924)	Beckinsale *et al.* (1978)	Morrison (1978) Thompson *et al.* (1982) Morrison *et al.* (1985) Thompson *et al.* (1986)
Central Group (= NPCMT) (Includes pillow lavas in central complex)	Not dealt with in detail	Some samples analysed, all zeolitized or hydrothermally altered.
Plateau Group (majority = PMT) Pale Group of Ben More (= PMT) (with interlayered mugearite and Big-Feldspar Basalt)	Group 1 olivine basalts (mainly sampled in north-west Mull) and Group 3 olivine basalts (mainly sampled around Lochaline, Morven)	Mull Plateau Group (MPG) Note that many are transitional between alkali basalt and tholeiite, and compare closely with Skye Main Lava Series. Some lower crust contamination.
(Staffa Type at base = NPCMT)	Group 2 of south-west Mull	Staffa Magma Type (SMT) Variably enriched in lower and upper crustal contaminants.

(NPCMT = Non-Porphyritic Central Magma Type) later = tholeiitic basalt
(PMT = Plateau Magma Type) later = alkali olivine basalt but many flows are in fact transitional between alkali basalt and tholeiite
Total thickness of Mull lavas estimated about 2000 m (Bailey *et al.*, 1924)

(Table 5.2) Classification and correlation of the Mull lavas