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## Chapter 9 Basalt lavas of central calderas. Sheet 44

All the 74 lava-specimens collected for microscopic examination from the two calderas (Area 10, of Index Map, p. 91) are of Central Types. Five of these specimens come from the north-western caldera, the rest from the south-eastern. Both porphyritic and non-porphyritic types are well represented, the former ranging from doleritic to compact in their groundmass; the latter are always compact, and sometimes very markedly so. Among the porphyritic lavas, there is often a nearer approach to the big-felspar basalt type than is at all common in the assemblages of Central Types met with outside the calderas. Good examples of these more coarsely porphyritic basalts are afforded by Bith Bheinn ([S15566](#)) [NM 5789 3466], ([S17129](#)) [NM 5795 3454] in the north-west caldera, and Cruach Choireadail ([S17184](#)) [NM 5932 2982] in the southeast.

It is hardly necessary to remark that fresh olivine, rusty weathered surfaces, and trap-featuring are everywhere conspicuously absent. In harmony with this, epidote is very commonly to be recognized in amygdales and cracks.

The extremely interesting tectonics of the district are dealt with more particularly in Chapters 13 and 32), E.B.B.

### The north-west caldera

The various patches of lava encountered in the north-western caldera are rendered so discontinuous by intrusions that nothing significant can be said of the distribution of the various types. Porphyritic basalts are prominent in Bith Bheinn ([S15566](#)) [NM 5789 3466], ([S17129](#)) [NM 5795 3454], and are recognizable again in Beinn na Duatharach ([S14684](#)) [NM 5953 3686]. In both cases, they are accompanied by typical non-porphyritic highly compact varieties ([S14683](#)) [NM 5953 3686], of which another good example forms the precipitous slope of Na Bachdanan at the head of a stream draining down to Loch Bà. Na Bachdanan lies within three miles of Salen and is easily located, so that it is likely to be visited by geologists wishing to familiarize themselves with the type. The crags yield thoroughly characteristic material, black on the broken face, and about as compact in texture as rhyolite. A specimen ([S14824](#)) [NM 5819 3928] collected here has been analysed (p. 17).

No pillow-structure has been noted among the lavas of the north-western caldera; but the vent-agglomerates are suspiciously free from gneiss-fragments ( (Figure 29), Chapter 16), so that perhaps the inbreak may have started at a comparatively early date. On the other hand, the most conspicuous feature of the caldera, as we know it to-day, is its girdle supplied by one of the latest intrusions of Mull, a ring-dyke of felsite which has taken its name from Loch Be (Chapter 32). W.B.W., J.E.R.

### The south-east caldera

The south-eastern caldera has been intensively studied since it has yielded so much of interest in the form of pillow-lavas. Its contents fall into three concentric zones, almost certainly of increasingly late date as one meets them successively (1–3) on traversing the caldera area towards its centre from either west or south:

1. In the outer zone of lava, the Central petrological characteristics are often ill-marked. Porphyritic feldspars are to be found in many of the flows, but seldom in profusion. There is a distinct tendency in many cases towards Plateau Type; but definite examples of the latter have not been found. Good exposures are afforded by Beinn Bhearnach (north-west of Sgùrr Dearg), Beinn Fhada, and Creag na h-Iolaire (west of Loch Airdeglais). (C.T.C), E.B.B., G.V.W.

2. The middle zone consists of highly porphyritic lavas crowded with feldspars. Some of the examples are rather coarser, approaching more nearly to the Big-Feldspar Type, than is common in the Central Outcrop outside the calderas. Exposures of lenticles preserved at intervals between cone-sheets are to be met with on Beinn Talaidh and Maol nam Fiadh. South of this, the belt is replaced by intrusions for a space, but can be picked up again at Ishriff, and continues into Cruach Choireadail where it is most conveniently studied. (C.T.C), E.B.B.

3. The interior zone consists entirely of very compact non-porphyrific basalts seen at many places. Of these one may cite: the southern stream at Doir' a' Mhàim; the junction of the two streams flowing south-west from Monadh Beag; the stream-banks between Ishriff and the main road; the first bend above the road of the little stream draining south-west from Tom na Gualainne; and so on to a little north of the summit of Cruach Choireadail. The exposures mentioned are from the outer margin of the area of compact lavas, where they come near their porphyritic fellows of Zone (2). The course of the line separating Zones (2) and (3) is indicated for a mile on (Figure 52) (p. 308). (C.T.C), J.E.R.

Pillow-structure, noted at many places ( (Figure 18) and (Figure 53), p. 312), frequently characterizes the lavas of Zones (1) and (2), but it is wanting in the interior. Zone (3). (c.T.e), E.B.B., G.V.W.

The petrological characteristics of the lavas of Zones (2) and (3) are strikingly Central, even in field-exposures. Those of Zone (1), as mentioned above, are less defined. Accordingly, Mr. Tait collected 25 specimens of lavas belonging to Zone (1), from east to west along a mile spanning the summit of Beinn Bhearnach, north of Sgùrr Dearg. On slicing ([S18876](#)) [NM 6615 3476], ([S18877](#)) [NM 6604 3471], ([S18878](#)) [NM 6600 3468], ([S18879](#)) [NM 6598 3466], ([S18880](#)) [NM 6596 3465], ([S18881](#)) [NM 6594 3463], ([S18882](#)) [NM 6593 3462], ([S18883](#)) [NM 6591 3460], ([S18884](#)) [NM 6590 3458], ([S18885](#)) [NM 6587 3456], ([S18886](#)) [NM 6585 3453], ([S18887](#)) [NM 6581 3449], ([S18888](#)) [NM 6579 3445], ([S18889](#)) [NM 6573 3444], ([S18890](#)) [NM 6571 3444], ([S18891](#)) [NM 6566 3439], ([S18892](#)) [NM 6561 3439], ([S18893](#)) [NM 6557 3435], ([S18894](#)) [NM 6555 3434], ([S18895](#)) [NM 6548 3433], ([S18896](#)) [NM 6543 3433], ([S18897](#)) [NM 6541 3430], ([S18898](#)) [NM 6537 3429], ([S18899](#)) [NM 6535 3428], ([S18900](#)) [NM 6527 3426], about half of these specimens ([S18880](#)) [NM 6596 3465], ([S18889](#)) [NM 6573 3444], ([S18890](#)) [NM 6571 3444], ([S18891](#)) [NM 6566 3439], ([S18892](#)) [NM 6561 3439], ([S18893](#)) [NM 6557 3435], ([S18894](#)) [NM 6555 3434], ([S18896](#)) [NM 6543 3433], ([S18897](#)) [NM 6541 3430], ([S18898](#)) [NM 6537 3429], ([S18899](#)) [NM 6535 3428], ([S18900](#)) [NM 6527 3426] proved to be typical Central Types. The remainder, mainly from the western end of the traverse, are intermediate in character between Central and Plateau Types, and will be referred to again in this connection in the petrological account (Chapter 10). E.B.B.

With reference to pillow-structure, it may be stated, in general, that individual pillows are often about 2 ft. long, and are clearly marked out by chilled margins and also by concentric zones of amygdales. (Figure 18) and (Figure 53) indicate several mapped exposures, but there is great difficulty in directing an observer with any confidence that he will find what he seeks in this matter; landmarks are scarce, the phenomenon searched for is often inconspicuous, and the general geological complexity is apt to prove bewildering. The following examples are, however, specially selected with a view to their being discoverable if carefully looked for:

1. If one follows the path, shown on the one-inch Map, from Torness across the flat watershed into the Glen Forsa drainage-basin, one presently meets a small stream (coming in from Beinn Bhearnach), 1 mile north-north-west of Torness. One hundred yards short of the crossing, in the acute angle between path and stream, and about 20 yds. from either, is a little crag of non-porphyrific lava with very typical pillow-structure (Plate 4)A. E.B.B.

2. A scenic feature of the Beinn Fhada ridge is a thick dolerite sill folded into a basin so that its outcrop surrounds the hollow of Coir' Odhar. At the north-east extremity of this outcrop (below the sill, but rather to the northwest) at the top of the slope from Coire Gorm, is seen a very thick coarsely porphyritic basalt with subordinate pillow-structure, and with pipe-amygdales in its base where it rests chilled upon a thin pumiceous tuff. This porphyritic flow has been mapped for a considerable distance and is about 120 ft. thick. Below it, in the section here considered, lies a non-porphyrific lava which affords a much more perfect example of pillow-structure. Its thickness is 35 ft., and, more particularly in its upper portion, it consists of pillows piled one on top of another with tuff between. From the base of each pillow spring pipe-amygdales, while small round amygdales in concentric zones occur at the sides and margins of the same ( (Plate 4)C). The two lavas just described, the non-porphyrific again showing good pillow-structure, can be easily located once more about 300 yds. farther southwest, just inside the outcrop of the Coir' Odhar sill. The exposure is a little west of a small lochan, shown on the one-inch Map, as resting half on the lavas and half on the sill.

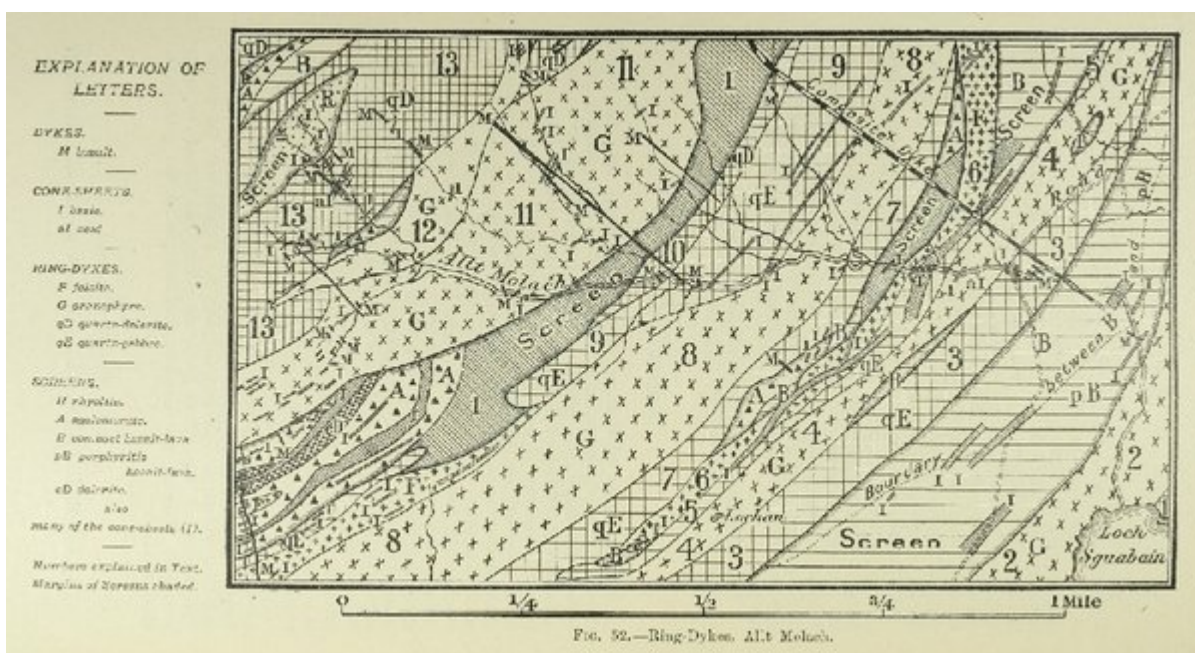
3. The geologist is well advised to approach the exposures enumerated in (2) by way of the little streams that drain into Loch Scuabain; for several examples of pillow-structure have been noted on the steep margin of the Beinn Fhada plateau overlooking the loch ( (Plate 4)B). G.Y.W.

4. On the southern slopes of Cruach Choireadail, between 300 yds. south-south-west and 500 yds. south of the summit, and again much nearer the road 1000 yds. south by west of the summit and 900 yds. east of Craig Cottage (that is about the 600 ft. level, in the angle of the outcrop of the Glen More Ring-Dyke, (Figure 54), p. 322), there are craggy exposures of coarsely porphyritic pillow-lava. Individual pillows measure 2–4 ft. across; and, though rude in shape and devoid of zonally arranged vesicles, they are conspicuous and show very marked chilling at their margins ( (Figure 21), p. 151). Between adjacent pillows, thin green or brown streaks with distinct fragmental structure have been frequently noticed together with harder patches of a pale-grey colour. Microscopic examination shows that these thin sedimentary and ashy infillings have been subjected to the same type of alteration as the associated lavas. (C.T.C.)

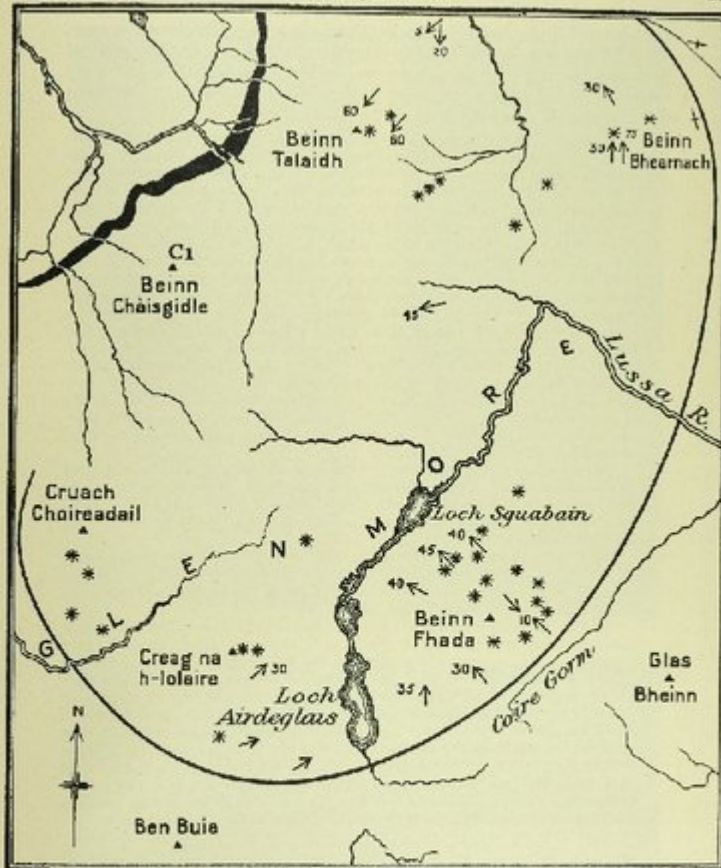
References have been made in the preceding paragraphs to contemporaneous tuff and sediments associated with the lavas of the caldera. So far as one knows at present, the phenomenon is always developed on a very minor scale. The most considerable example as yet recognized has been described in Chapter 3, p. 66. Two other very interesting cases may now be mentioned: one is situated on Beinn Bhearnach, where a dip of  $75^\circ$  is indicated on the one-inch Map, one mile west-north-west of the summit of Sgùrr Dearg; the other is exposed in a stream where an arrow marks a dip of  $45^\circ$ , 600 yds. east and 200 yds. north of the south-west corner of (Figure 53) (p. 312). At both localities, tuffs interbedded with the basaltic lavas of the south-eastern caldera are seen containing fragments of fluxion-rhyolite. The Beinn Bhearnach example is more readily found than might be expected, for it occurs at the foot of a little escarpment sufficiently marked to attract attention. Here one foot of fine sediment, along with the tuff containing rhyolite, separates two coarsely crystalline somewhat porphyritic pillow-lavas. The Doir' a' Mhàim tuff is easily recognized in stream-section where it passes beneath vesicular lavas of the compact non-porphyritic type. It is clear then that acid tuff was more than once available during the period of the basic lavas of Central Types found within the caldera. Very possibly, further research will show that in a few cases, where tuff has been assigned to necks on the one-inch Map, it is in reality interbedded among the lavas (p. 197).  
E.B.B.



(Figure 29) Distribution of gneiss-fragments in Mull Agglomerates.



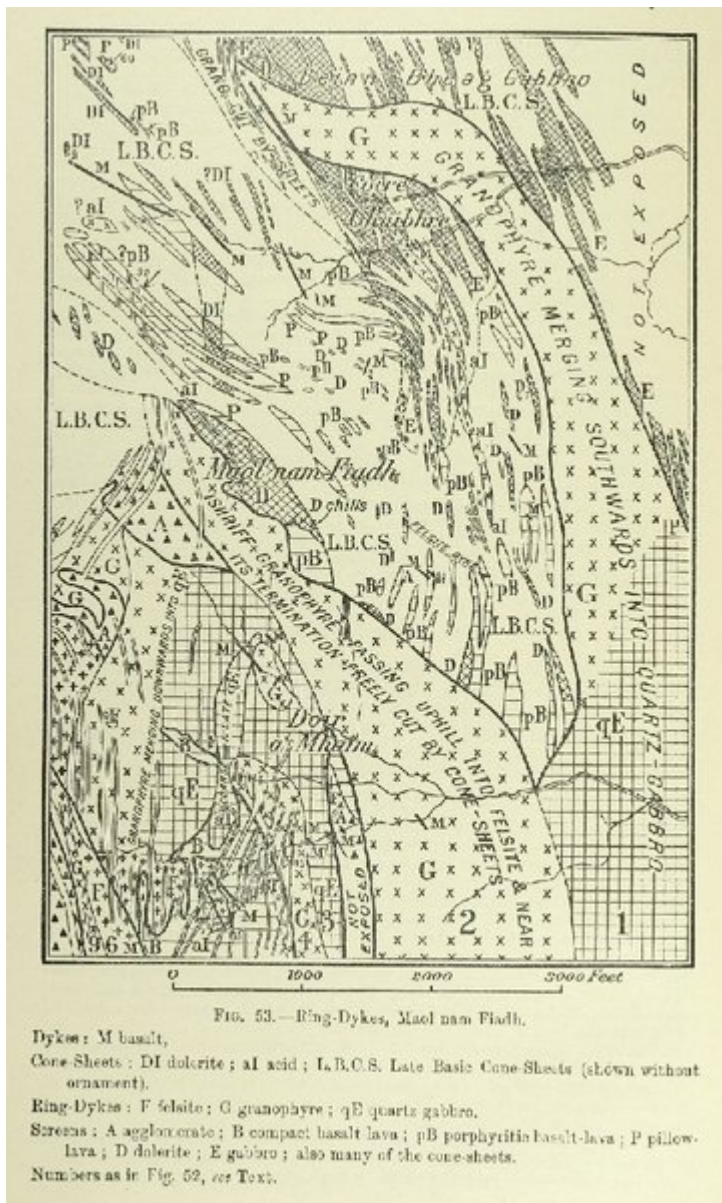
(Figure 52) Ring Dykes, Allt Melach.



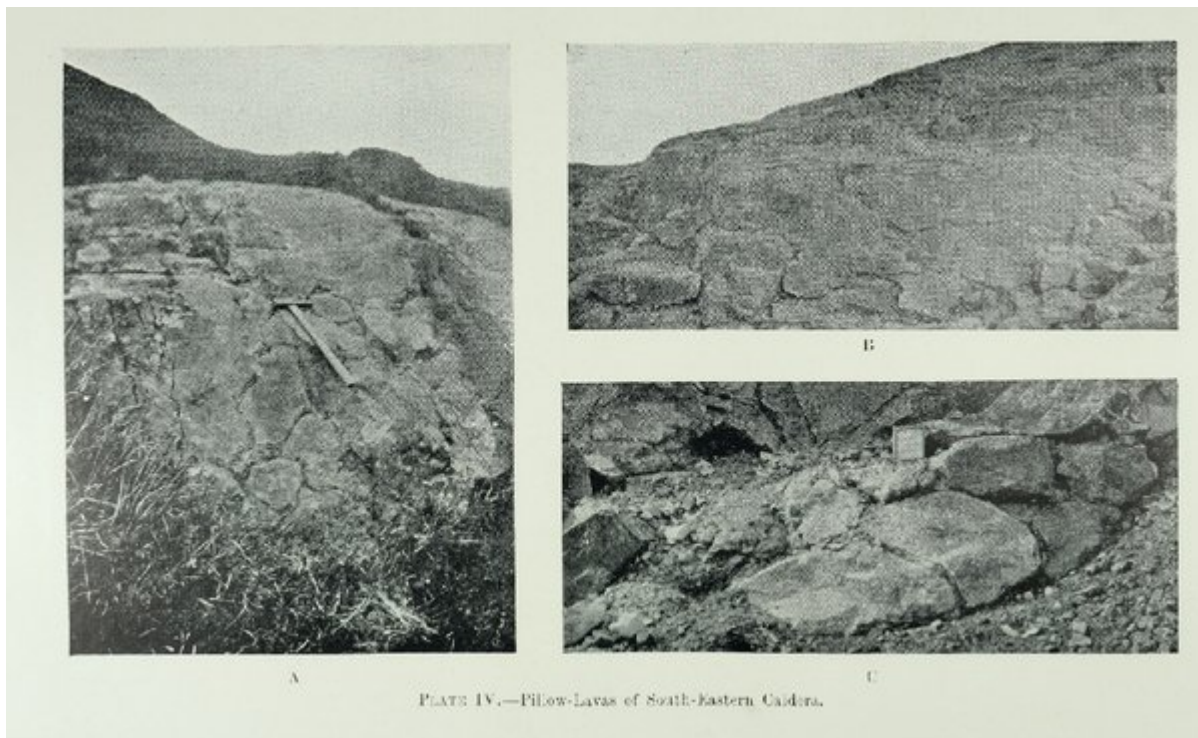
- \* Exposure of Pillow-Lavas
  - ↘ Dip, in degrees, of Lavas, Tuffs, and Sediments.
  - ⊗ Vertical Lavas.
  - ⊖ Inferred edge of Caldera, left incomplete owing to lack of outcrops.
  - Loch Fà Mìne-Dyke
- C<sub>1</sub> = Early Course of Fig. 65, p. 386.

FIG. 18.—Distribution of Pillow-Lavas, Mull.  
 Quoted from 'Summary of Progress for 1914,' p. 40.

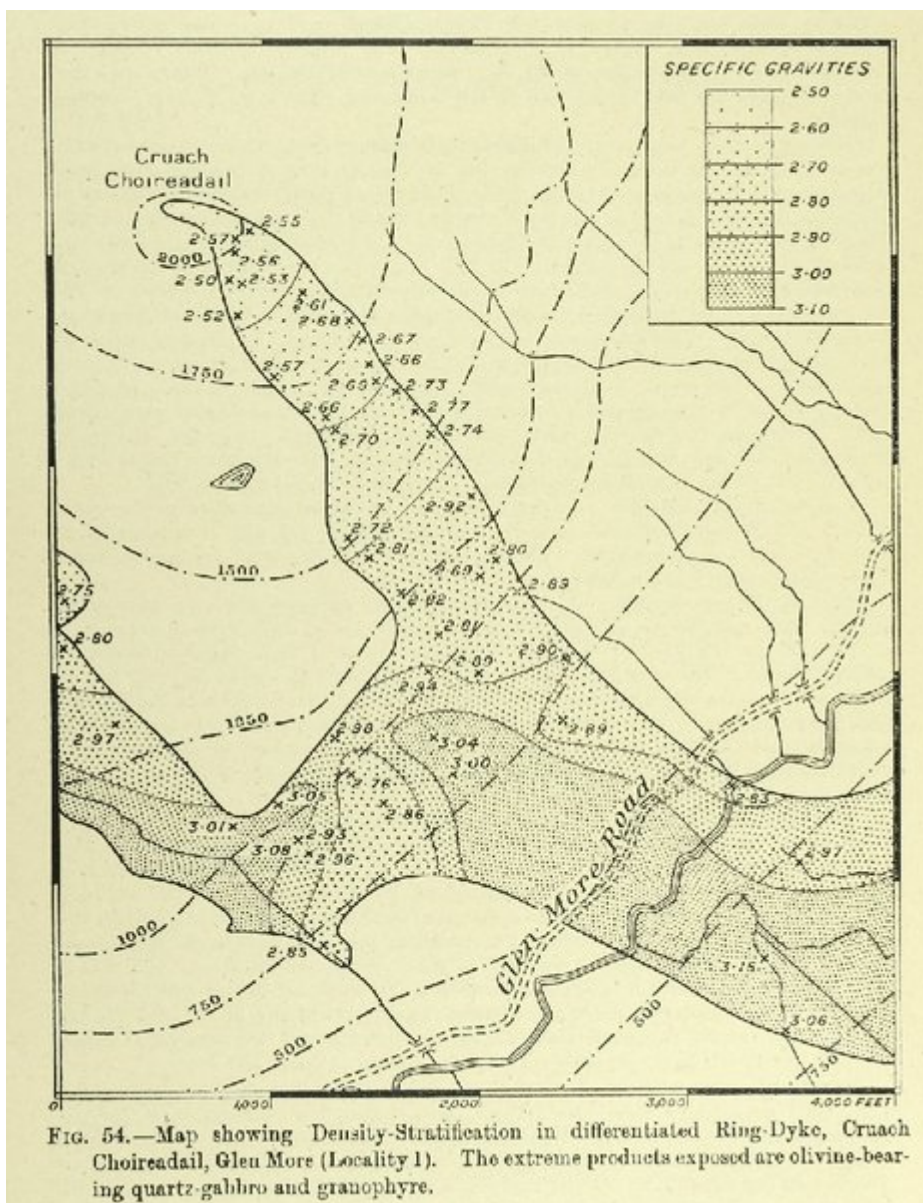
(Figure 18) Distribution of Pillow-Lavas, Mull. Quoted from Summary of Progress for 1914, p. 40.



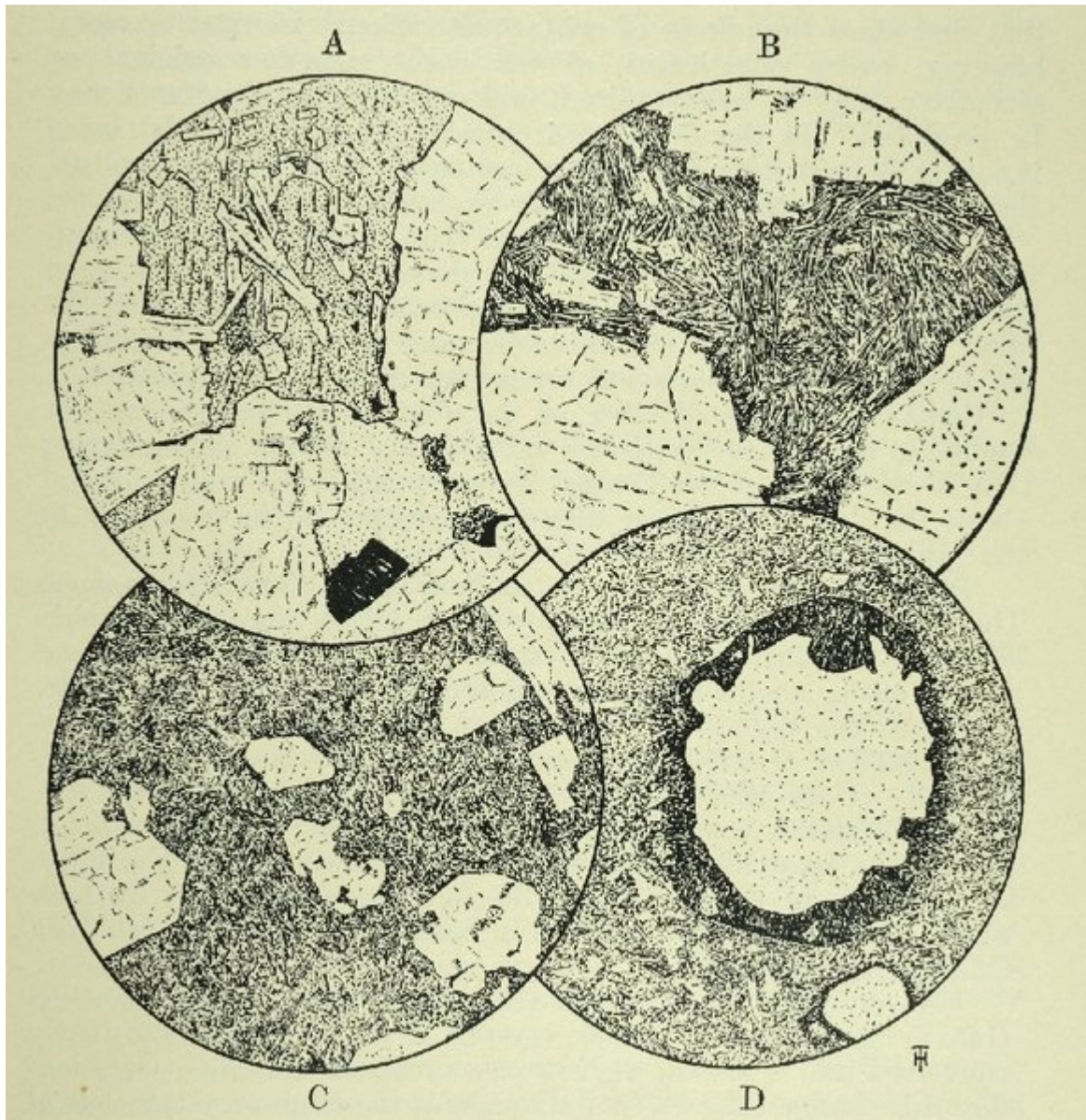
(Figure 53) Ring-Dykes, Maol nam. Fiadh. Dykes: M basalt, Cone-Sheets: DI dolerite; al acid; L.B.C.S. Late Basic Cone-Sheets (shown without ornament). Ring-Dykes: F felsite; G granophyre; qE quartz-gabbro. Screens: A agglomerate; B compact basalt-lava; pB porphyritic basalt-lava; P pillow-lava; D dolerite; E gabbro; also many of the cone-sheets. Numbers as in Figure 52, see Text.



(Plate 4) Pillow-lavas of central Mull



(Figure 54) Map showing Density-Stratification in differentiated Ring-Dyke, Cruach Choireadail, Glen More (Locality 1). The extreme products exposed are olivine-bearing quartz-gabbro and granophyre.



(Figure 21) A -C Pillow-Lava, Cruach Choireadail. D Beinn Fhada. A. [\(S17184\)](#) [NM 5932 2982] x 17. Interior of Pillow. Moderately coarse doleritic rock with the augite and feldspar in ophitic relationship. B. [\(S17185\)](#) [NM 5940 3000] x 17. Exterior of Pillow. The feldspar occurs in two generations as porphyritic crystals of bytownite-anorthite, and as slender laths, which, with elongated crystals of augite, impart a variolitic structure to the matrix (compare with (Figure 23a, p. 163). C. [\(S17186\)](#) [NM 5924 3011] x 17. Chilled Margin of Pillow. Porphyritic basic plagioclase, near anorthite in composition, in a fine-textured matrix. The ground-mass is composed of small, elongated crystals of feldspar, augite and iron-ore, with a chloritized residuum probably representing glass (compare with Fig 23A, p. 163). D. [\(S18039\)](#) [NM 6437 2936] x 17. Beinn Fhada. Portion of the exterior of a pillow showing the characteristic invasion of vesicular cavities by mesostatic residual material which has subsequently frothed up in situ.