Chapter 19 Intermediate and acid cone-sheets

Introduction

The sheets considered here are lettered al on the one-inch Map (Sheet 44), where they are described in the index as Acid Centrally Inclined Sheets or Cone-Sheets. The former title is unduly cumbrous, but it gives a good idea of a cone-sheet complex in which the characteristic feature is an assemblage of sheets inclined rather steeply towards a common centre. The term cone-sheet is employed because the sheets, viewed as members of a suite, suggest the partial infilling of a number of co-axial cone-shaped fractures with inverted apices united underground. In the case of the Mull intermediate and acid cone-sheets, the average inclination is about 30° or 40°. The centre about which most of them are grouped agrees approximately with C1 of (Figure 18) and (Figure 58) (p. 133, 338).

The intermediate and acid cone-sheets are not so numerously developed as their basic analogues to be described later (Chapters 21 and 28). Their two main localities are: North-east of the Mull centre, on the lower slopes overlooking the Sound of Mull, especially above Scallastle Bay, and, south of the centre, on the southern face of Ben Buie.

The thickness of the individual sheets often exceeds 30 ft.

The subject-matter is treated below under three main headings:

1. Under Date of Intrusion, it is shown that many of the intrusions here considered are among the earliest cone-sheets of Mull; at the same time, they are later than the arcuate folding of Chapter 13, and the early paroxysms or Chapters 15 and 16. Where the term Early Acid Cone-Sheets is employed in the course of this Memoir, it implies intermediate and acid cone-sheets of at least as early a date as the Early Basic Cone-Sheets of Chapter 21.

2. Under Composite Intrusion, it is pointed out that, like other minor acid intrusions of Mull, their marginal layers, showing externally chilled edges, are often of relatively basic composition (pp. 8, 32).

3. Under Petrology, it is explained that, though indexed on the one-inch Map as acid, the commonest type is a sub-acid or intermediate rock defined as craignurite.

Date of intrusion

The intermediate and acid cone-sheets of Mull frequently intersect and chill against one another. Close enquiry further shows that in some cases they are of widely different ages. At the same time, they all seem to be later than the great explosions that have left their agglomerates in the semi-circular tract leading from Beinn Chreagach Bheag, through Sgùrr Dearg, to the southern slopes of Ben Buie (Chapters 15 and 16). In fact five of their number have been traced through the Beinn Mheadhon Felsite of Chapter 17, which is itself clearly later than the agglomerates of its neighbourhood. E.B.B., G.W.L.

It will be remembered that it is open to discussion whether the agglomerates just mentioned are earlier or later than the arcuate folding illustrated in (Plate 5) (p. 165). The intermediate and acid cone-sheets are certainly of later date than this folding. An acid sheet-complex is well exposed on the Craignure shore ((Figure 25), p. 174), where its posteriority to the folding can be established on two grounds:

1. The acid complex, apparently undisturbed, is intruded into sediments and intrusions which are tilted, smashed, and faulted. A very good section opposite the United Free Church Manse shows the base of an acid sheet cutting clean across obvious crush-lines (p. 176).

2. Dykes of acid material, apparently identical with that of the sheets, occur along both the faults shown on the map at the south end of Craignure Bay—the one inland behind the Inn, the other reaching the coast north-east of the Pier. (p. 176).

Similarly, in the Loch Don area, a sheet of craignurite, inclined at about 45° towards the south-west, can be traced from the Loch Don Bridge right across vertical Old Red Sandstone lavas situated on the east side of the Loch Don Anticline (*see* one-inch Map).

Early Acid Cone-Sheets

While later than the folding, many of these intermediate and acid cone-sheets seem to belong to a more or less initial stage of the long period during which the Early Basic Sheets of Chapter 21 were intermittently injected. Evidence bearing upon this point comes from the district between the Sound of Mull and Glen Forsa, and also from Ben Buie. In the former, craignurite and granophyre cone-sheets lie for the most part outside the area of maximum development of the Early Basic Cone-Sheets; but, at the same time, they are very commonly cut by thin dolerite and basalt sheets which probably belong to the Early Basic suite. A striking instance of intersection (shown on the one-inch Map) occurs in a stream three -quarters of a mile north-west of Lochan an Doire Dharaich, above Loch Don. In this case, the intersecting sheet is a fine gabbro, markedly vesicular. On the other hand, the largest and one of the earliest of the Early Basic Sheets of this district—the gabbro of Beinn Chreagach Mhòr ((Figure 36), p. 238)—is traversed by a couple of craignurite cone-sheets which chill against it. E.B.B.

On the southern slopes of Ben Buie, the relatively early date of many intermediate and acid cone-sheets is clearly demonstrable owing to the gabbro of the mountain cutting right across the outcrop of a very representative suite of craignurite cone-sheets (one-inch Map and (Figure 38), p. 247). The Ben Buie Gabbro, as described in Chapter 22, also cuts across very numerous representatives of the Early Basic Cone-Sheets, but at the same time it is itself cut by the later representatives of that assemblage. G.W.L., G.V.W.

Late Acid Cone-Sheets

It must be admitted that a small and indeterminate proportion of intermediate and acid cone-sheets is of later date than the Ben Buie Gabbro. Thus, for instance, an acid, or intermediate, cone-sheet is one of the few to traverse the little isolated outcrop of Ben Buie Gabbro occurring in Coire na Feela, between Glas Bheinn and Creach Beinn; and another (not shown on the one-inch Map) cuts the Beinn Bheag Gabbro of Chapter 22 in exposures reaching southwards from Coire Ghaibhre ((Figure 53), p. 312). E.B.B.

Some of the late acid cone-sheets are not of the ordinary craignurite-granophyre facies. Yellow felsite sheets on the slopes of Beinn Bhearnach, east of Torness (two are shown on the one-inch Map), cut the Early Basic Cone-Sheets with which they come in contact. Small-felspar felsite sheets are not uncommon in the south-east extremity of the Glen Cannel Granophyre of Chapter 31. One is shown on the map in the River Cannel, above the burial ground. W.B.W., E.B.B.

Small-felspar felsite sheets with basic margins occur commonly in the caps of the Beinn a' Ghràig Granophyre of Chapter 32. In this case, however, it is not clear whether one is dealing with true acid cone-sheets. The felsites seem to be in connexion with the underlying granophyre, and as the caps which they traverse are largely made of Late Basic Cone-Sheets, perhaps the felsites may be merely apophyses of the granophyre guided by joints up the middle of pre-existing cone-sheets. It would be extremely interesting if it could be established that the felsites here are genuine cone-sheets springing from the great Ring Dyke of Beinn a' Ghràig—for a connexion between cone-sheets and ring-dykes is not even hinted at in any other Mull exposure. J.E.R.

Composite intrusion

A large proportion of the intermediate and acid cone-sheets are composite, in that their outer margins, extending inwards for some two or three feet, are more basic than their interiors. Often, the division between basic margin and more acid interior is quite conspicuous, but nothing that can be styled a chilled edge separates the two. Field-relations of a few typical cases will be considered there, while petrological details are taken later (p. 228).

Four representative examples may be cited from what may be styled in general terms the Sound of Mull Area. The first reaches Scallastle Bay near Altcrich Cottage, where a note draws attention to it on the one-inch Map. The upper and lower margins of a thick felsite sheet are here seen constituted of 2 ft. of basalt (tholeiite). The latter is, as is the rule in such cases, chilled exteriorly, but not interiorly. Another interesting feature, observable on the shore at this point, is the veining of the upper basaltic layer by acid material from below. It may be added that the exposure is further noteworthy because of two large xenoliths situated just above the lower basic layer: one a slab, 6 ft. long, of *gryphea*-limestone; the other a streaky rock which has resulted from a gneiss in which the mica's have melted to glass (p. 229).

The second example is to be found on the shore of Craignure Bay, opposite the United Free Church Manse. Here the basal layer consists of 3 ft. of fine-grained basalt, and the acid layer immediately above is charged with fragments, up to 3 inches long, of a related intermediate rock.

The third example is chosen from a little beyond the Sound of Mull on the shore south of the entrance to Loch Don. The composite nature of this sheet is less conspicuous than in the two just described. It is possible that there has been a gradual merging from basic to acid due to digestion of the former by the latter.

The fourth example is taken from an easily reached and recognizable inland occurrence. A thick cone-sheet of intermediate composition, and rather coarse crystallization, has been traced intermittently for a couple of miles in Glen Forsa, where it passes under Gaodhail and Tomslèibhe Cottages. Its outer margins, top and bottom, consist of a foot or two of dolerite of tholeiitic type, well chilled against the augite-diorite of Chapter 18, which serves as country-rock. A feature of this Glen Forsa sheet is the fact that it is cut to pieces by the Late Basic Cone-Sheets of Chapter 28. E.B.B.

The examples cited above come from the Sound of Mull Area, but the phenomenon of composite intrusion is widespread. A striking case is afforded by a thick craignurite cone-sheet which passes through the spur indicated on the one-inch Map by a southward deflection of the 1,000-ft. contour on the southern slopes of Ben Buie. This great craignurite-sheet has two or three feet of intimately connected basalt of dolerite at both top and bottom, and as usual the basic margins are clearly chilled against the country rock. G.W.L.

It is important to realize that the tendency to composite habit on the part of the intermediate and acid cone-sheets is not confined to any period of intrusion. The instances so far considered very probably all belong to the Early Acid Cone-Sheets. It has been pointed out that some of the acid cone-sheets are of later date, among them the yellow felsites east of Torness, and the small-felspar felsites cutting the Glen Cannel Granophyre. These later felsites also afford typical examples of composite sheets. E.B.B.

Petrology

The intermediate and acid rocks that occur as cone-sheets, although presenting numerous characters that indicate close genetic relationship, exhibit considerable variety in texture, and have a fairly wide range in chemical composition. Amongst their more acid members, they include felsites and fine-grained granophyres, but it is the intermediate and sub-acid members that call for special attention in so far as these rock-types are represented to an exceptional degree in Mull.

Craignurite and its allies

(Anals. I. and VI., (Table 3), p. 19; II., (Table 4), p. 20).

Of the intermediate cone-sheets the dominant type is that to which we apply the name craignurite because it is well represented in the neighbourhood of Craignure. Three rocks were chosen for chemical analysis. One of these is characteristic of the greater number of the sheets to which the name is applied, while the others mark approximately the respective limits of the type in an acid and basic direction. These three selected specimens (Figure 33) will be described in some detail, and, then after a few supplementary remarks based upon other material, a precise definition of craignurite will be attempted.

The analysed typical craignurite (S16802) [NM 6903 3752], p. 19) consists essentially of a highly characteristic network of narrow elongated crystals of augite, and skeleton-crystals of oligoclase and andesine set in a fine-textured acid divitrified base (Figure 33)A. There are a few stumpy porphyritic crystals of labradorite and occasional large crystals of magnetite, but the rock cannot in any ordinary sense be termed porphyritic.

The long augite-prisms have been converted into green hornblende and serpentine, with an accompanying separation of granular sphene. The bulk of the felspar occurs as narrow zoned crystals of oligoclase and andesine, which give skeletal outlines in section, either box-like, hour-glass shaped, or forked, and indicate a rapid growth, more especially at edges and corners. The matrix is devitrified and of a brownish-grey colour. It is traversed in all directions by crystallites of oligoclase felspar and magnetite, and the ultimate products of crystallization are orthoclase, albite, and quartz, in perthitic and micro-granophyric relationship. The grey colour of the ground-mass is due partly to turbidity of the alkali-felspar and partly to widely disseminated minute crystals of magnetite. Apatite is not an abundant accessory.

In the granophyre of craignurite affinity from Craignure shore (S16803) [NM 7167 3731], p. 20), the ferro-magnesian constituents are less strongly represented, although of similar habit to those in the type-craignurite; and the felspars, though skeletal in form, are smaller in size and altogether less prominent. The bulk of the rock is made up of the material that constituted the ground-mass of the craignurite, and has been similarly devitrified into micro-perthitic and micro-granophyric areas, but with a somewhat greater separation of clear quartz.

The basic craignurite (S16800) [NM 6857 3750], p. 19) owes its increased basicity to the stronger development of basic plagioclase, an increase in the amount of augite, and a diminution in the amount of acid matrix. The felspars, apart from those which belong more properly to the matrix, are elongated prisms of acid labradorite usually once twinned. They are associated with brownish-yellow hypidiomorphic prisms of augite and patches of iron-ore. The augite almost invariably has a fine lamellation parallel to the base (salite-structure). Twinning parallel to the orthopinacoid is a common feature. Intergrown with this augite, frequently occupying a central position, but occasionally in less definite relationship, is another pyroxene (*see* below) now almost always represented by serpentinous pseudomorphs. The matrix, as before, shows a characteristically immature type of crystallization: augite assumes a markedly acicular habit, and the felspars become more acid in composition and increasingly skeletal in form. Albite-oligoclase forms the larger individuals, but the ultimate product of crystallization is a perthitic and micro-granophyric residium that has crystallized in a patchy manner and has included slender needles of oligoclase, minute acicular crystals of augite, and finely divided magnetite. There is a tendency for the matrix to collect into areas, often of considerable size, that are more or less devoid of the larger crystalline individuals—a character often remarked upon in connexion with the acid matrix of quartz-dolerites, for instance, those of the Scottish Lowlands. It may be added that the Craignure Type at its basic end is linked closely in texture and composition with the quartz-dolerites of Talaidh Type described in Chapter 28.

As has been stated, the greater number of Mull craignurites group themselves about the type-rock described above, but one point of considerable interest must be emphasized, namely, the almost constant occurrence, either within or in close association with normal aluminous augite, of another pyroxene that in most cases is represented only by pseudomorphs. In the elongated augites, it may be seen to form a narrow central zone of variable width, and, at other times, it may appear as a more complex intergrowth. In quartz-dolerites from other regions a similar relation is often noted between monoclinic and rhombic pyroxenes, and it is quite possible that a rhombic pyroxene has been present in some of the Mull craignurites, for it is often met with in the leidleites (Chapter 25) which differ from the craignurites in little but texture. At the same time, no fresh rhombic-pyroxene has been found in the craignurites, while, in more than one instance, it is possible to demonstrate from unaltered remnants (S14879) [NM 5314 2250], (S15539) [NM 6857 3750] that the pyroxene forming the core of the normal augite is also a monoclinic pyroxene in optical continuity with its envelope. In such cases, the earlier pyroxene undoubtedly belongs to the group of minerals known as enstatite-augite, and agrees with the pyroxene-phenocrysts of the inninmorites (p. 284).

Among the more acid craignurites, an approach to porphyrite is occasionally encountered (S15544) [NM 6903 3752], (S15542) [NM 6877 3755], (S14924) [NM 5558 2569]. Acicular and elongated augites are smaller than in the normal rock, and we note the incoming of glomero-porphyritic groups of labradorite felspar (usually albitized) along with rounded pseudomorphs after enstatite augite, such as are characteristic of the inninmorite sills. The matrix, however, retains the character met with in the more basic rocks. but becomes greater in amount. There is a progressive suppression of its

larger felspathic components, and a still more pronounced development or skeletal individuals (S14222) [NM 7452 3016], (S14223) [NM 6857 3183]. Acid craignurites of this variety grade into closely allied felsites and granophyres. In these rocks, an acid character is demonstrated by an abundance of quartz, both free and iu micro-granophyric growths; while craignuritic tendencies are shown by acicular augite, in the matrix, and also by glomero-porphyritic groups of albitized labradorite, enstatite-augite, and magnetite (S16951) [NM 5513 3196], (S16950) [NM 5513 3196], (S16460) [NM 6874 3913].

Additional examples of the more basic varieties of craignurite, comparable with the analysed specimen, are (S15554) [NM 7471 3171], (S16593) [NM 5389 3096], (S16804) [NM 7409 3305]. Commonly, pseudomorphs after enstatite-augite, or possibly in some instances a rhombic pyroxene, form cores to the elongated crystals of aluminous augite, and less frequently occur as isolated crystals (S16593) [NM 5389 3096]. In exceptional cases, it may be the only ferro-magnesian constituent (S14879) [NM 5314 2250]. Olivine is sometimes represented in the more doleritic types as rare pseudomorphs (S16364) [NM 6057 2518].

In conclusion the following definition of the type is offered:

The craignurites range in silica-percentage from about 55–70, and their most characteristic representatives have about 65 per cent. SiO_2. They differ from the augite-andesites of Chapter 25 in possessing a more mature type of crystallization, which at the same time has not developed so far as in the case of the augite-diorites of Chapter 18. In the field, they are grey moderately fine-grained rocks characterized by an acicular development of their chief constituents. Microscopically, they consist essentially of columnar and acicular aluminous augite and elongated skeletal crystals of a zoned ande-sine and oligoclase, in a matrix that appears to be the rapidly crystallized representative of a glassy base. The aluminous augite is generally associated with a non-aluminous variety which most frequently forms the central portion of the elongated crystals, or may exist as separate micro-porphyritic individuals. The matrix usually shows an intricate network of slender and skeletal acid plagioclase-crystals, set in the ultimate products of crystallization which are patches of microperthitic and microgranophyric material with minute areas of free quartz.

Among the other varieties of acid cone-sheets, we may mention a Small-Felspar Felsite Type, a description of which is given in the following section on Composite Cone-Sheets. An easily located sheet (S13899) [NM 6366 4078], 700 yards south-south-west of Corrynachenchy House, south of Fishnish Bay, is a variant of the type, and has characters that ally it to the innininorites. It consists of a small, but abundant, phenocrysts of albitized labradorite and pseudomorphed enstatite-augite in a felsitic matrix that locally assumes a sub-spherulitic structure.

A few cone-sheets crossing Allt an Dubh-choire above Scallastle Bay, Sound of Mull, may be regarded as variants of the Craignure Type (S15533) [NM 6787 3716], (S15534) [NM 6799 3725], (S15538) [NM 6846 3749]. Their matrix has a definitely microlithic character. Augite is moderately abundant, and retains the acicular habit as in the craignurites, but is more evenly distributed throughout, and usually of smaller dimensions than ,that met with in the typical rocks.

The acid cone-sheet that crosses the A'Chioch *arête* of Ben More (S17159) [NM 5343 3350] is a compact fluxionally banded rock of trachytic character. It has practically no phenocrysts, except an occasional small albite, and is composed of microlithic felspar that has straight extinctions, with minute areas of devitrified felspathic matter and clear quartz and rusty iron ores.

Passing west of Maol na Samhna, south of the head of Loch Scridain, another sheet (S14673) [NM 5450 2509], (S14900) [NM 5419 2765], (S16743) [NM 5557 2816] is a compact rock, more or less holocrystalline, with trachytic or orthophyric affinities. It consists mainly of stout prisms of albite-oligoclase and orthoclase, with interstitial quartz and chloritic pseudomorphous patches after augite. The augite mostly occurs as minute acicular prisms.

Composite cone-sheets

Petrological data will now be furnished in regard to composite cone-sheets illustrated by slices in the Survey collection. Some of these cone-sheets have already been introduced to the reader's notice (p. 223).

In the cone-sheet at Altcrich on the shores of Scallastle Bay, the acid interior portion (S16459) [NM 6874 3913] is a compact felsite showing, occasionally, a tendency towards a spherulitic structure. The more definite crystalline constituents are oligoclase in microlithic crystals and a subordinate decomposed acicular augite. The bulk of the rock, however, is made up of micro-perthitie and micro-granophyric patches resulting from devitrification. The margins (S16460) [NM 6874 3913], (S16457) [NM 6874 3913] are of a moderately basic tholeiitic rock that approximates to a fine-grained olivine-dolerite. The augite has a subophitic development, and remnants of olivine remain fresh.

The cone-sheet at Craignure (S15550) [NM 7167 3731], (S16803) [NM 7167 3731] has an interior that has already been described as a granophyre with marked craignuritic affinities (p. 226). Its margins (S15552) [NM 7167 3731] are of moderately coarse doleritic olivine-tholeiite (Salen Type, p. 301) with a sub-radial grouping of augite and felspar.

The interior of the cone-sheet on the shore south of Loch Don (S14222) [NM 7452 3016] is a typical craignurite of somewhat acid character, while the margins (S14221) [NM 7452 3016] consist of a fairly coarse olivine-tholeiite of Salen Type, containing a small amount of alkaline residual matter.

The small-felspar felsites, mentioned on more than one occasion as late representatives of the acid cone-sheets, are frequently of a composite nature. Their interior portions consist of small phenocrysts of albite-perthite and albite, with less conspicuous pseudomorphs after enstatite-augite (S14756) [NM 6099 3454], (S14758) [NM 5875 3281], (S14760) [NM 5938 3296], in a devitrified patchy granophyric and perthitic base. The matrix forms the bulk of the rock, and exhibits the same characters as the base of the acid craignurites, in that there is a fmely acicular crystallization of augite. The margins vary in composition and texture from tholeiites (S14757) [NM 6099 3454] to basic craignurites (S14759) [NM 5875 3281], (S14761) [NM 5938 3296].

A suite of specimens (S14377) [NM 6162 3454], (S14378) [NM 6162 3454], (S14379) [NM 6162 3454], (S14380) [NM 6162 3454], taken from a composite cone-sheet (not shown on the one-inch Map), 1000 yds. west-south-west of the summit of Beinn Talaidh, proves the central portion (S14379) [NM 6162 3454] to be a pale soda-granophyre, with moderately large porphyritic albite and perthite crystals in a beautifully spherulitic base. The marginal portions approximate to the Talaidh Type of quartz-dolerite. The rock contains an abundance of hypidiomorphic to granular augite associated with somewhat elongated small crystals of once-twinned oligoclase, evenly distributed magnetite, and a little free quartz. H.H.T., E.B.B.

Xenoliths

Accidental xenoliths are a very rare feature of this suite of intrusions, but certain occurrences are worthy of mention. The gneiss xenolith (S16451) [NM 6185 3914], that occurrs immediately above the basic bottom layer of the Altcrich Sheet (p. 223), shows that the felspars have fluxed to a considerable extent, formed a copious melt with the magmatic material which has invaded the rock, and solidified as a clear glass. The remaining felspar exhibits evident signs of dissolution, and quartz has either dissolved with the formation of small crystals of rhombic pyroxene or, if incompletely dissolved, is fringed with this material. Biotite has been partly resorbed, and has given rise to an aggregate of small rectangular crystals of cordierite, which are crowded with minute dark-brown to black spinets. The cordierite is partly pinitized. The glassy base contains trichitic crystals of pyroxene, and has devitrified with a spherulitic tendency into feathery growths of alkali-felspar.

Another xenolith (S16456) [NM 6411 4029] from a neighbouring sheet of craignurite, collected from the course of the main stream almost three-quarters of a mile above Corrynachenchy House, is of pegmatite with a glassy reaction-selvage. Glass has developed along the margins of the felspars, and between felspars and quartz. The felspar shows characteristic mottling due to reheating. The glass has devitrified giving rise to sub-spherulitic growths of alkali-felspar with, probably, some quartz. H.H.T.

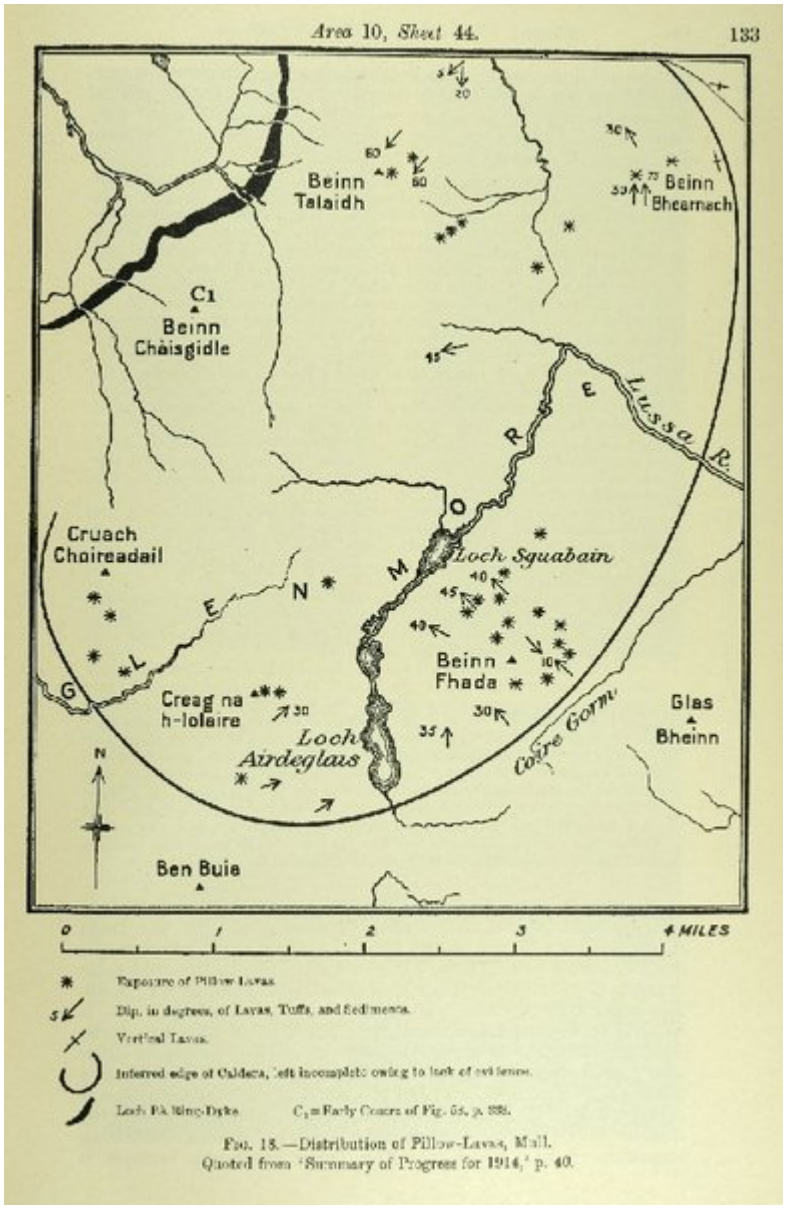


FIG. 18.—Distribution of Pillow-Lavas, Mull.
Quoted from 'Summary of Progress for 1914,' p. 40.

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

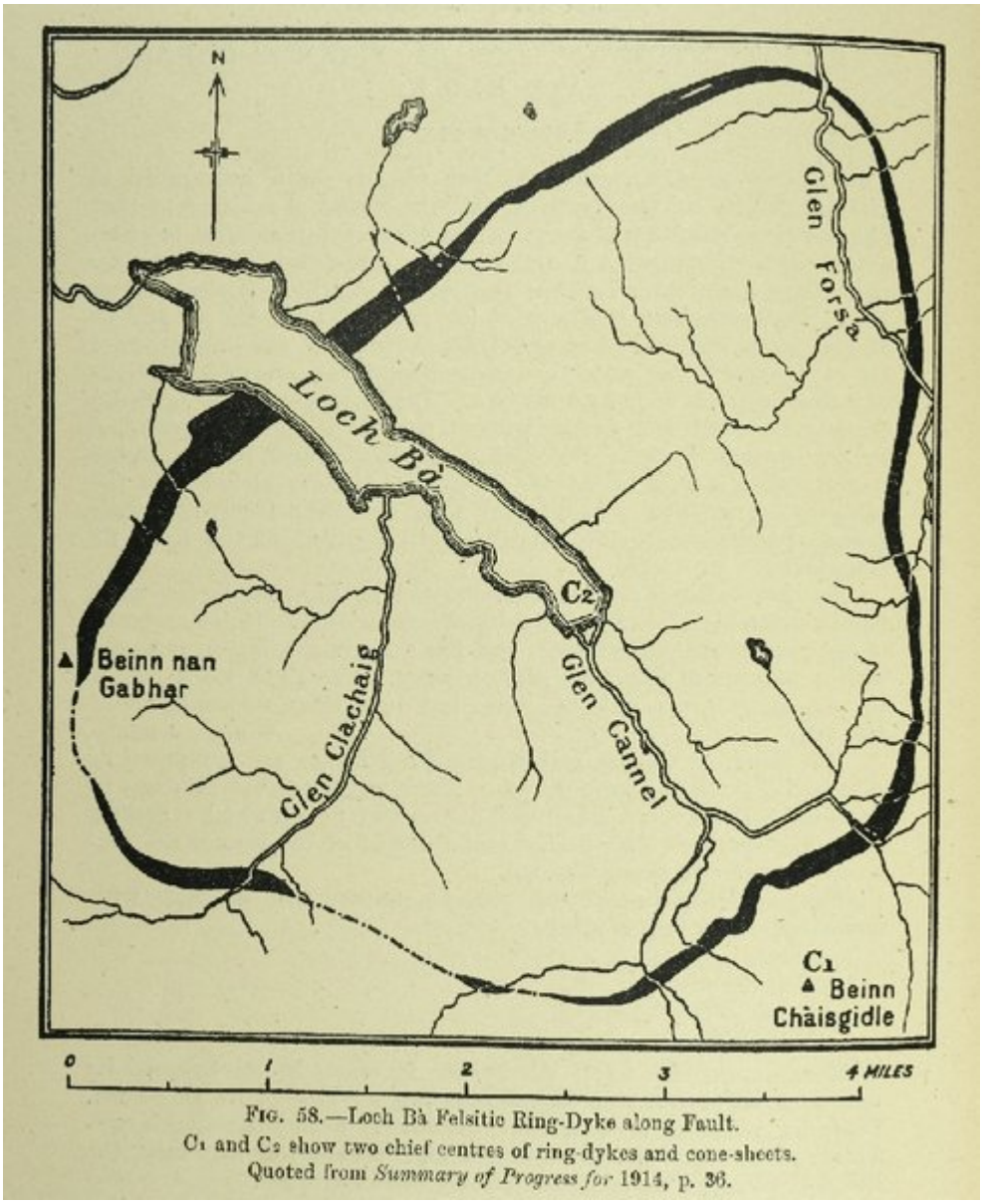
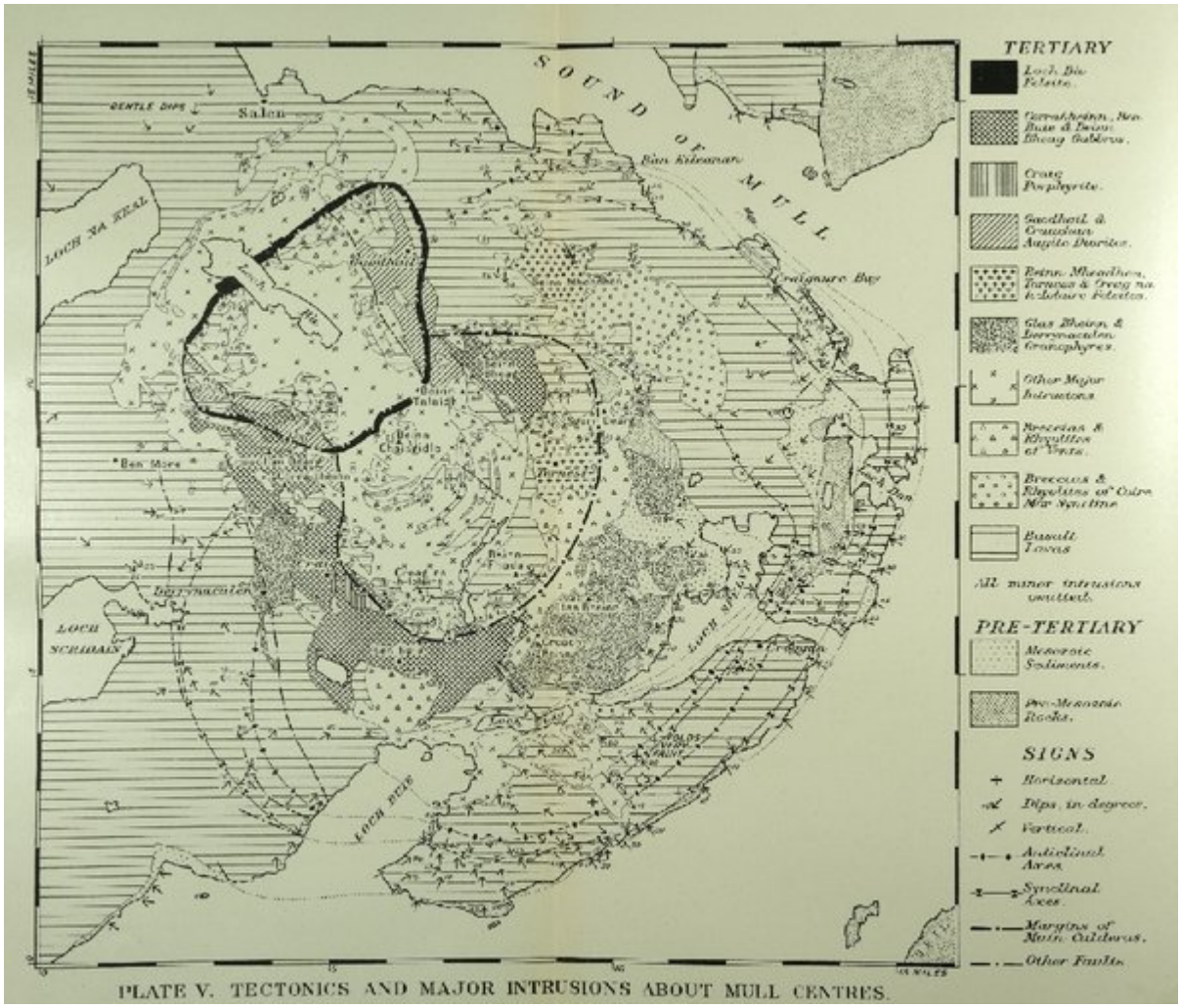
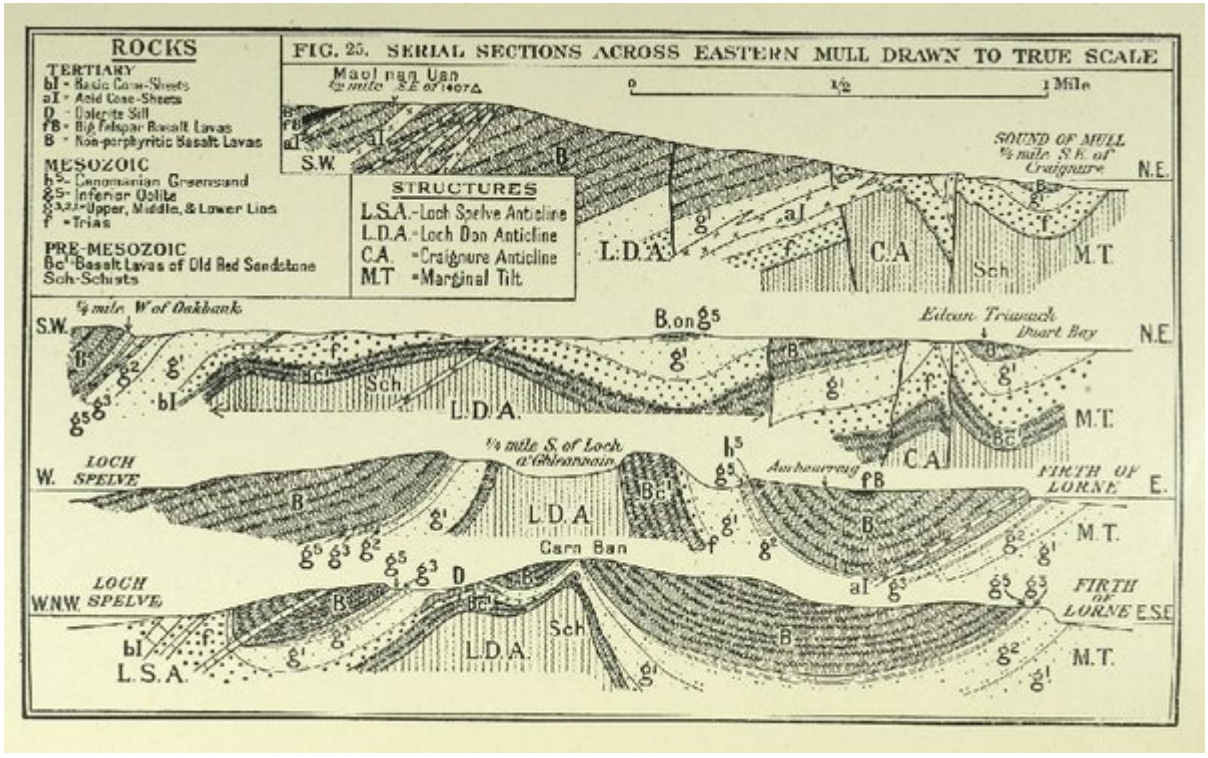


FIG. 58.—Loch Bà Felsitic Ring-Dyke along Fault.
C1 and C2 show two chief centres of ring-dykes and cone-sheets.
Quoted from *Summary of Progress for* 1914, p. 36.

(Figure 58) Loch Bà Felsitic Ring-Dyke along Fault. C1 and C2 show two chief centres of ring-dykes and cone-sheets. Quoted from Summary of Progress for 1914, p. 86.



(Plate 5) Map showing calderas, major intrusions, and folds



(Figure 25). Serial sections across Eastern Mull drawn to true scale. Rocks, Tertiary: bl = Basic Cone-Sheets aI = Acid Cone-Sheets D = Dolerite Sill fB = Big Felspar Basalt Lavas B = Non-porphyritic Basalt Lavas. Mesozoic: h^5 = Ceitomanian Greensand g^5 = Interior Oolite $g^{3,2,1}$ = Upper, Middle.& Lower Lias f = Trias. Pre-Mesozoic: Bc^1=Basalt Lavas of Old Red Sandstone; Sch=Schists. Structures: L.S.A.=Loch Spelve Anticline. L.D.A.=Loch Don Anticline. C.A.

=Craignure Anticline M.T. =Marginal Tilt.

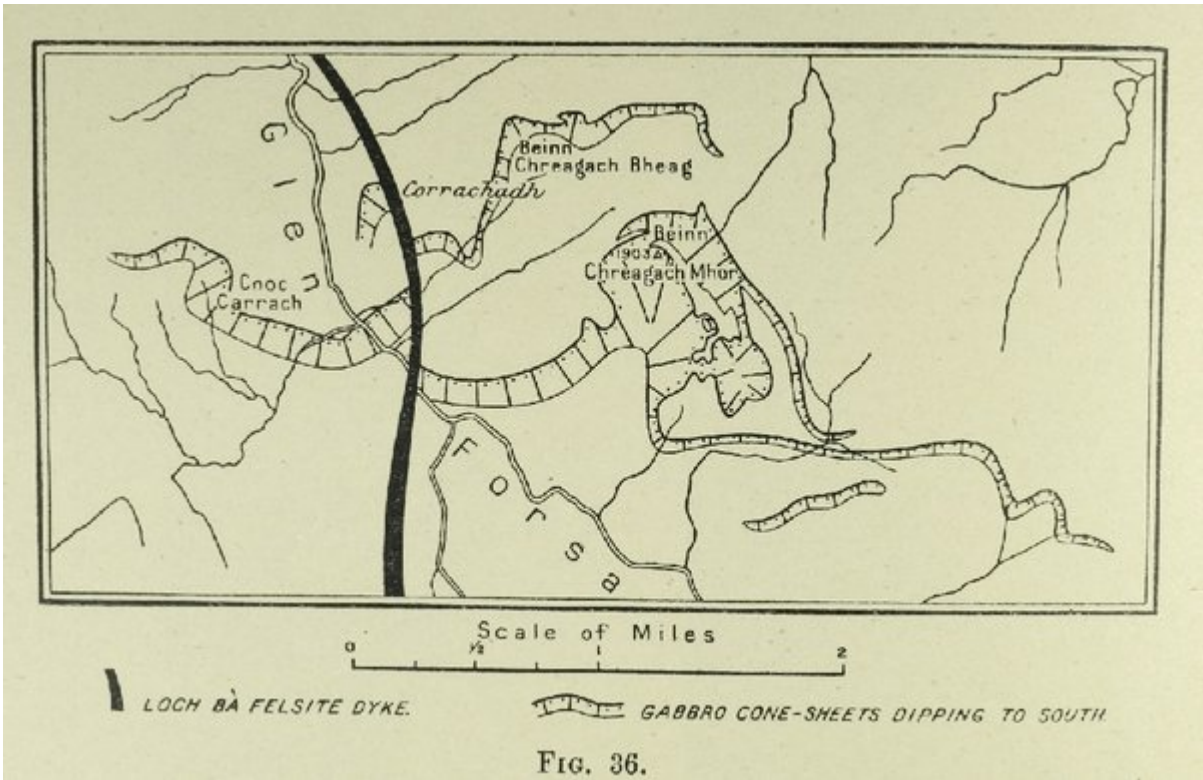


FIG. 36.

(Figure 36) Early Basic Cone-Sheets of Beinn Chreagach Bheag and Beinn Chreagach Mhòr probably displaced at Loch Bà Felsite.

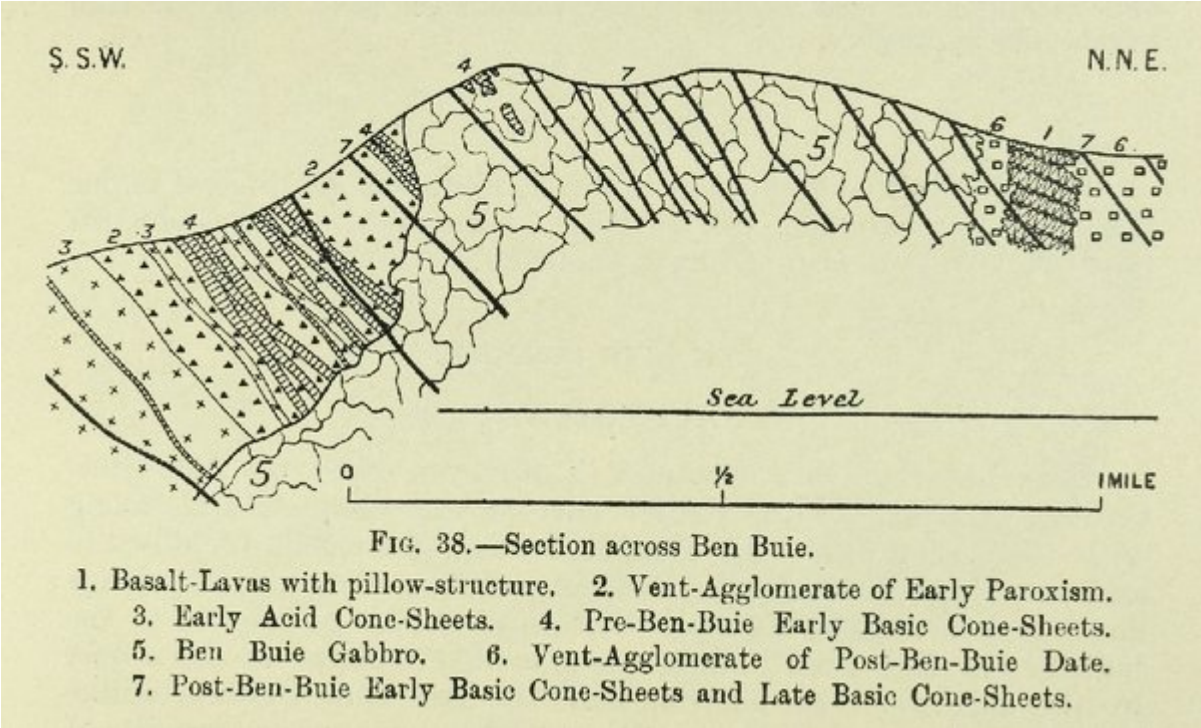


FIG. 38.—Section across Ben Buie.

1. Basalt-Lavas with pillow-structure. 2. Vent-Agglomerate of Early Paroxism.
3. Early Acid Cone-Sheets. 4. Pre-Ben-Buie Early Basic Cone-Sheets.
5. Ben Buie Gabbro. 6. Vent-Agglomerate of Post-Ben-Buie Date.
7. Post-Ben-Buie Early Basic Cone-Sheets and Late Basic Cone-Sheets.

(Figure 38) Section across Ben Buie. 1. Basalt-Lavas with pillow-structure. 2. Vent-Agglomerate of Early Paroxism. 3. Early Acid Cone-Sheets. 4. Pre-Ben-Buie Early Basic Cone-Sheets. 5. Ben Buie Gabbro. 6. Vent-Agglomerate of Post-Ben-Buie Date. 7. Post-Ben-Buie Early Basic Cone-Sheets and Late Basic Cone-Sheets.

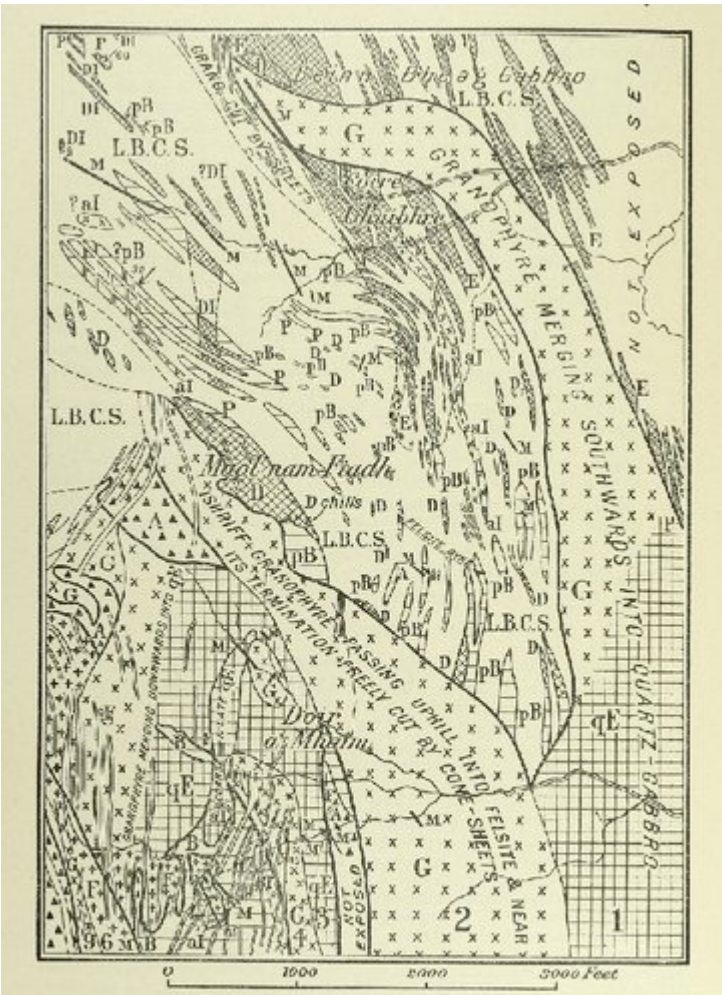


FIG. 53.—Ring-Dykes, Maol nam Fiadh.

Dykes: M basalt,

Cone-Sheets: DI dolerite; aI 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 Fig. 52, *see* Text.

(Figure 53) Ring-Dykes, Maol nam. Fiadh. Dykes: M basalt, Cone-Sheets: DI dolerite; aI 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.

TABLE III.—Intermediate to Subacid Magma-Type of Fig. 2.

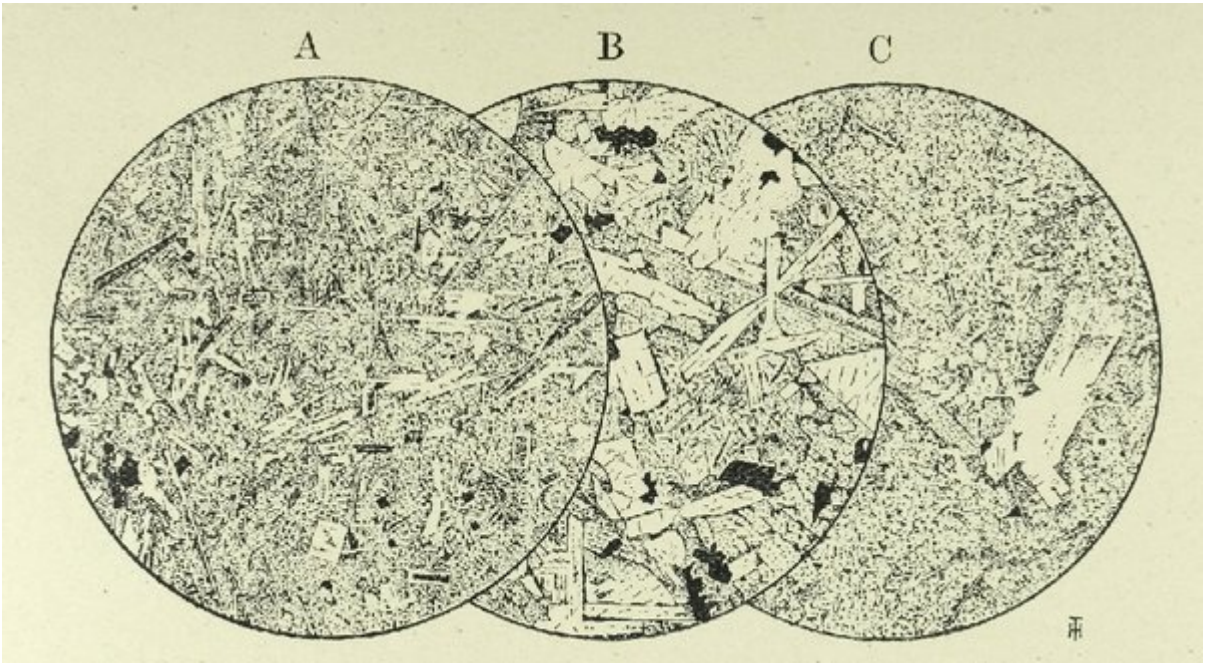
	Craignurite (basic)	Leidleite		Inninmorite		Craignurite (acid)	
	I.	II.	III.	IV.	V.	VI.	
SiO_2 . .	55·82	59·21	61·69	62·37	64·13	66·27	SiO_2
TiO_2 . .	1·62	1·06	1·00	1·06	1·19	0·87	TiO_2
Al_2O_3 . .	11·47	14·06	14·43	12·04	13·15	11·92	Al_2O_3
Fe_2O_3 . .	3·68	2·66	1·23	1·87	1·08	3·09	Fe_2O_3
FeO . .	7·66	4·87	5·86	5·81	6·31	3·18	FeO
MnO . .	0·40	0·24	0·30	0·24	0·27	0·31	MnO
(Co,Ni)O .	0·04	nt. fd.	nt. fd.	nt. fd.	nt. fd.	nt. fd.	(Co,Ni)O
MgO . .	4·08	3·71	2·81	0·97	1·08	1·44	MgO
CaO . .	7·88	5·95	4·97	3·51	3·62	3·30	CaO
BaO . .	0·03	0·03	0·04	0·07	0·09	nt. fd.	BaO
Na_2O .	2·58	2·06	3·20	3·47	3·64	2·89	Na_2O
K_2O . .	2·00	2·83	1·72	2·34	2·32	4·03	K_2O
Li_2O . .	tr.	nt. fd.	nt. fd.	nt fd.	nt. fd.	tr.	Li_2O
$H_2O+105°$.	1·88	1·49	2·32	5·54	2·71	1·51	$H_2O+105°$
H_2O at 105°	0·66	2·06	0·25	0·44	0·36	0·78	H_2O at 105°
P_2O_5 . .	0·23	0·20	0·24	0·30	0·31	0·17	P_2O_5
Co_2 . .	0·08	...	...	...	...	0·53	Co_2
FeS_2 . .	0·09	nt. fd.	nt. fd.	nt fd.	nt. fd.	nt. fd.	FeS_2
Cl . .	...	nt. fd.	0·02	...	...	...	Cl
	100·18	100·43	100·08	100·03	100·26	100·29	
Spec. grav.	2·88	2·61	2·64	2·50	2·57	2·65	

(Table 3) Intermediate to Subacid Magma-Type of Figure 2

TABLE IV.—Acid Magma-Type of Fig. 2.

	I.	II.	III.	IV.	V.	
SiO_2	70·70	71·30	72·66	73·12	73·32	SiO_2
TiO_2	1·27	0·58	0·34	0·39	0·51	TiO_2
Al_2O_3	11·78	11·24	12·00	12·44	12·25	Al_2O_3
Fe_2O_3	1·32	1·80	2·03	2·09	2·77	Fe_2O_3
FeO	3·45	2·84	2·04	1·65	2·20	FeO
MnO	0·07	0·31	0·18	0·17	0·12	MnO
(Co,Ni)O	...	nt. fd.	nt. fd.	nt. fd.	nt. fd.	(Co,Ni)O
MgO	0·53	0·61	0·07	0·14	0·11	MgO
CaO	1·30	1·56	1·25	0·88	1·65	CaO
BaO	...	0·07	0·12	nt. fd.	0·09	BaO
Na_2O	2·48	3·44	3·26	3·90	3·92	Na_2O
K_2O	4·71	4·66	5·26	4·67	2·34	K_2O
Li_2O	...	? tr.	nt. fd.	nt. fd.	nt. fd.	Li_2O
$H_2O + 105°$	1·14	1·04	0·47	0·24	0·35	$H_2O + 105°$
H_2O at 105°	0·50	0·39	0·22	0·25	0·35	H_2O at 105°
P_2O_5	0·26	0·22	0·04	0·09	0·10	P_2O_5
CO_2	0·51	...	0·24	0·05	0·06	CO_2
FeS_2	...	nt. fd.	nt. fd.	nt. fd.	nt. fd.	FeS_2
S	0·08	...	...	...	...	S
	100·10	100·06	100·18	100·08	100·14	
Spec. grav.	2·58	2·53	2·61	2·57	2·66	

(Table 4) Acid Magma-type of Figure 2



(Figure 33) Craignurite and Allied Granophyre. A. [(S16802) [NM 6903 3752]] ×15. Normal Craignurite from Allt an Dubh-choire. The structure is highly characteristic. The rock consists of a network of narrow elongated crystals of augite and skeleton-crystals of oligoclase and andesine enclosing a fine-textured acid devitrified ground-mass. B. [(S16800) [NM 6857 3750]] ×15. Basic variety of Craignurite from Allt an Dubh-choire. This rock shows a coarser type of crystallization and differs from the normal type in the greater basicity of its felspar and in a diminution in the amount of acid matrix. The usual acicular type of crystallization is preserved. C. [(S16803) [NM 7167 3731]] x 15. Granophyre allied to Craignurite from Craignure shore. This rock contains the usual elongated crystals of augite and occasional small

felspars of the craignurites. It differs, however, in its preponderance of acid matrix in the form of microperthitic and microgranophyric areas.