Chapter 14 Syenite, trachytes, and bostonites

Introduction

A few alkaline intrusions are considered at this juncture. They are lettered as follows on the one-inch Map: syenite S; trachyte O; bostonite bO. There is no suggestion made that all these intrusions belong to a single epoch; since there is little known in regard to their precise age-relationships. On the other hand, the evidence in every case, except that of the Gamhnach Mhòr Syenite, does conclusively demonstrate a Tertiary date, and often supplies further information as indicated presently under the heading of Field-Relations. The fullest record is furnished in regard to the bostonite-suite; and there is some justification for referring these particular intrusions, in part at any rate, to a phase of the epoch of maximum explosive activity dealt with in Chapters 15 and 16. It is this circumstance that has decided the position of the present chapter in the general scheme of the Memoir.

The Gamhnach Mhòr Syenite cannot be seen to cut Tertiary or Mesozoic rocks—in fact it is surrounded by the waters of Carsaig Bay—but there are two good reasons for considering it as of Tertiary date: in the first place, the syenite occurs in a region replete with Tertiary intrusions, some few of which are closely akin to it in composition; in the second place, there is no intrusion of Pre-Tertiary date anywhere in the West Highlands with which this syenite can be equally well compared.

The syenite, trachytes, and bostonites of this chapter are grouped together for petrological convenience. It must not be thought, however, that they are petrologically isolated in the Mull assemblage. They merely mark an extreme of alkali-variation corresponding with a certain range of silica-percentage; they have, on one side, a close connexion with the mugearite-lavas described in Chapter 10; and, on the other side, with certain granophyres, for instance the Glen Cannel and Beinn a' Ghràig Granophyres (Chapters 31 and 32). This aspect of the subject is developed further in the introductory chapter, (Figure 4), p. 26.

A brief statement of the field-relations of the various occurrences is given below, and is followed by a petrological account.

Field relations

Gamhnach Mhòr Syenite, Carsaig (Sheet 44)

This syenite forms a low island and reef at the entrance to Carsaig Bay on the south coast of Mull. It is probably intruded into Mesozoic or Pre Mesozoic rocks, but the sea conceals its margin. It is traversed by three of the numerous basic sheets of its district and a couple of dykes. The sheets run roughly east and west, and one of them (S14597) [NM 5458 2057] is described by Dr. Thomas as a tholeiite with cognate xenoliths, exactly recalling the basic marginal portions of the Rudh' a' Chromain sill (p. 286). It is thus sufficiently clear that the syenite is earlier than the Loch Scridain sills of Chapter 23; but as yet the age of these latter is only fixed within somewhat wide limits (p. 279). (B.L.)

Trachytic vent and sill of Braigh a' Choire Mhòr (Sheet 44)

A mile west of Salen, rising above the lava-slopes which overlook the Sound of Mull, there stands a conspicuous little crag consisting of trachyte, surrounded on three sides by trachytic agglomerate. The trachyte is further marked out from the basalt-lavas by its felspathic appearance and its twisted platy structure. There can be no question that the associated agglomerate marks the site of an explosion-vent piercing the basalt-lavas, and measuring some 400 by 200 yds. The trachyte-crag is thus almost certainly part of a central plug belonging to the vent. W.B.W .

Although the trachyte of the plug is isolated as a scenic feature, it appears probable on close examination that it unites on its east side with a trachyte-sill which continues for about three quarters of a mile beyond the limit of the vent. J.E.R.

As regards age, it is obvious that the trachyte must be of later date than the lavas which it cuts, while it must be of earlier date than certain north-west basalt-dykes which have been traced across it. One of these dykes may be seen traversing the vent, and two others cut the attendant sill. The time-limits set by these observations are of course rather vague. W.B.W., J.E.R.

Trachyte-plug of Ardnacross (Sheet 52)

A considerable mass of intrusive trachyte is well-exposed about four miles north-northwest of Salen, close by the farm of Ardnacross. It extends for a mile along the coast of the Sound of Mull, and forms the promontories of Rudh' an t-Sean-Chaisteil and Rudh' a' Ghlaisìch. The country-rock of the district is furnished by basalt-lavas.

The trachyte is characterized by platy joints, which in most places vary rapidly in inclination. Within a distance of 80 yds. from the lavas, however, they become regular so as always to incline steeply from the line of junction. The actual contact of trachyte and basalt is not exposed, for at the only place where the edge of the trachyte is seen (in coast-section, on the south side of Rudh' a' Glaisìch) a narrow lenticular band of agglomerate separates it from the lavas. The usual platy jointing fails within a foot of this agglomerate, and the trachyte adopts a definitely chilled texture. Both exposed junctions, between trachyte and agglomerate, on the one side, and agglomerate and basalt-lavas, on the other, appear vertical. The trachyte-margin obviously maintains this verticality inland, since its course pays no regard to the shape of the ground.

The coastal strip of agglomerate contains subangular blocks of basalt up to four feet in length, and also a mass of red bole. It may be interpreted as broken-up basalt-lava, shattered by an explosion which preceded the intrusion of the trachyte-plug. There is thus a close connexion between the mode of occurrence of the Ardnacross Trachyte and that of Bràigh a' Choire Mhòr just described. The similarity is increased by the fact that the Ardnacross Plug is freely cut by north-west basalt-dykes. J.E.R.

Lochan na Cille Trachyte (Sheet 44)

The only other considerable trachyte-intrusion to be mentioned is a mass of biotite-trachyte crossing the northern border of Sheet 44 near Lochan na Cille, east of Savary Glen. It builds conspicuous crags running north-northeast. Towards its margins, it develops a strong streaky structure with steep inward dip. Perhaps the mass is best described as an elongated plug. It has not been sliced, so that no mention of it will be found in the petrological section. (H.B.M.)

Bastonites between Ben More and Carsaig (Sheet 44)

An interesting minor feature of the geology of the district reaching from Ben More southwards to the sea-coast near Carsaig is the occasional occurrence of bostonite as sheets and more irregular intrusions. In most cases, the bostonite is porphyritic. The most prominent example is a gently inclined sheet, 50 ft. or more in thickness, shown on the one-inch Map a little south of Rossal Farm, near the head of Loch Scridain. It has conspicuous phenocrysts of felspar in a very felspathic ground-mass, sometimes weathering a characteristic pink. Farther north, two similar occurrences are shown on the Map towards the head of Gleann Dubh, and another half a mile east of this glen terminates southwards a little northeast of Dùn Breac. As will appear presently, it is not quite certain that the last-named is not a lava. Another rather important outcrop, though not indicated on the one-inch Map, is exposed on the south shore, where it is cut across by the xenolithic composite sill of Rudh' a' Chromain ((Figure 45), p. 267). In this instance, the bostonite is non-porphyritic. E.M.A., G.V.W

A comparatively early date of intrusion for these bostonites is shown by the fact that the type-occurrence at Rossal is cut across by thin examples of the Early Basic Cone-Sheets of Chapter 21, and also by a subacid cone-sheet probably belonging to the Early Acid Suite of Chapter 19. This evidence is strengthened, and the age-limit carried one stage further back, by the finding of bostonite-fragments (S16274) [NM 5491 3218]–(S16275) [NM 5491 3218] in a vent situated in the Sleibhte-coire, between Thu na h-Uamha and Guibean Uluvailt (p. 207). The Sleibhte-coire Vent is a good example belonging to the maximum period of explosive activity (Chapter 16); and its agglomerate, which contains many fragments of gneiss, is cut through alike by Early Basic Cone-Sheets and Corra-bheinn Gabbro, the latter described in

Chapter 22. (C.T.C), G.V.W.

It will be shown almost immediately that there is a possibility of the bostonites being in part contemporaneous with the Central Basalt lavas of Chapter 5. At the same time, there is considerable circumstantial evidence that some of them at any rate are of later date, and belong to the maximum explosive phase described in Chapters 15 and 16. There is nothing contradictory in these two views, for, as pointed out at the close of Chapter 9, rhyolitic tuffs are occasionally found intercalated among Central Basalts, despite the fact that rhyolite figures much more prominently in the subsequent paroxysmal outbursts of Chapters 15 and 16.

The evidence for associating bostonites with the paroxysmal phase in its more westerly manifestations is as follows:

1. If a bostonite-magma has not shared in the explosions which give rise to the Sleibhte-coire Vent, it is a curious coincidence that Dr. Clough's specimens of tuff, chosen haphazard from this vent, should show an abundance of bostonite-fragments. The vent falls roughly within the area characterized by bostonite-outcrops; but even in this area, bostonite bulks to an insignificant extent in the Mull Complex, and in the vicinity of the vent it does not show at the surface at all.

2. The coincidence mentioned above is heightened by the fact that bostonite, along with gneiss, etc., figures in a small patch of tuff (S15618) [NM 5777 2823]–(S15619) [NM 5777 2823] entangled among Early Basic Cone-Sheets on Tòr a' Ghoai, between Glen More and Loch Fuaran. The tuff-patch is too small to show on the one-inch Map; but in its relations to the Early Basic Cone-Sheets, and in its content of gneiss-fragments it exactly resembles the Sleibhte-coire and other vents of the maximum period of explosive activity. Here again, the specimens of tuff were collected by Dr. Clough without any thought of their containing bostonite. E.B.B.

3. Near the type-exposure of bostonite south of Rossal Farm, a minute patch of breccia containing bostonite-fragments may be seen in contact with amygdaloidal basalt-lavas. Appearances suggest that the breccia rests upon the lavas; but, taken in conjunction with somewhat similarly situated patches of breccia in Other cases in Central Mull, it is fairly safe to interpret this particular occurrence as a product of explosion filling some small irregular cavity. The exposure lies half-a-mile east-south-east of Rossal Farm between the two branches of acid cone-sheet which are shown on the one-inch Map as uniting in the tributary stream south of Allt a' Mhàim. The evidence in this case suggests that where bostonite is known to occur it has a tendency to develop explosive phenomena, which supports the suggestion made to account for the phenomena detailed under headings (1) and (2). G.V.W.

The evidence noted above, as suggesting a possible contemporaneity of bostonite with Central Basalts, is furnished in a stream east of Beinn nan Gobhar, a mile and a half north of the bridge at the head of Loch Scridain. On the one-inch Map, the locality is most easily recognized as the eastern margin of a bostonite-sheet, where this latter lies north of a branching east and west fault and east of a north and south fault. The bostonite is of the usual porphyritic type with anorthoclase phenocrysts, and was regarded at the time of mapping as an intrusion, largely on account of its petrological analogy with other bostonites of the district, themselves clearly-marked intrusions. Above it, at the side of the stream, 5 ft. of sediment is exposed, including a band of ashy grit. This gritty layer, on examination by Dr. Thomas, proved to be to all appearance a crystal-tuff of anorthoclase (S16939) [NM 5419 3134]. As the sediment seems interbedded in the Central Basalt sequence, its constitution affords strong presumptive evidence that bostonitic explosions sometimes intervened between outpourings of Central Basalt lavas. Also, its association with a bostonite-sheet raises the question whether bostonite in this case may not be a lava. Since the recognition of these possibilities, no opportunity has presented itself for a re-examination of the field-evidence.

It may be added that the same sheet of bostonite has been traced southwards to where it is shown on the one-inch Map as terminating north-east of Dùn Breac. At this point, it is cut, across by a small outcrop of volcanic breccia (not shown on Map) containng fragments of bostonite visible in hand-specimens. The volcanic nature of the breccia is fairly certain, for its boundaries seem steep, and some of its fragments have vitreous margins. There is, however, nothing to show that its association with the bostonite is more than accidental. It is probably the contents of a small explosion-vent.

Petrology

Syenite of Gamhnach Mhòr, Carsaig

(Anal. II.; (Table 7), p. 27).

The rock of Gamhnach Miler is definitely an alkaline syenite (S14596) [NM 5461 2063], (S14597) [NM 5458 2057], (S14598) [NM 5473 2056], (S15991) [NM 5463 2063]. Its general colour is yellowish grey-brown, with dark ochreous spots. The texture is holocrystalline, though rather fine for a syenite; and phenocrysts of any size are wanting.

The fractured surface is rough, and glistens with small crystals of a somewhat greasy-looking felspar, which lie at all angles and are mostly from one to two millimetres in length.

In the hand-specimen, the syenite is quite unlike any other rock from Mull, and the microscope proves it to consist essentially of alkali-felspars with subordinate amounts of alkaline pyroxenes and hornblendes. Plagioclase is entirely wanting. The structure of the rock is hypidiomorphic-granular, and in some sections is reminiscent of the coarser-grained bostonites that are often devoid of conspicuous fluxion-structure. Felspar forms at least 75 per cent. of the rock, and the rest consists of basic silicates, accessory minerals such as magnetite and apatite, and limonitic decomposition products. Coarser-textured segregation-veins are present, but they show no special departure from the normal mineralogical assemblage (S14598) [NM 5473 2056]. A considerable variation in the relative proportions of the basic silicates is a noticeable feature of this rock, as it is indeed of many rocks of the class; in fact, one basic silicate may predominate locally to the almost complete exclusion of the others.

The felspar is elongated in a positive direction parallel to the a axis, and is tabular parallel to the plane of symmetry; while carlsbad twinning is the rule. Unlike normal orthoclase, but in common with certain felspars of the alkali-syenites, the axial plane lies in the plane of symmetry and is thus parallel to the trace of the good cleavage (010). The mineral is optically negative with 2E between 60° and 70°.

The habit appears to be that of sanidine, but, as found by Williams<ref>J. F. Williams, The Igneous Books of Arkansas, Ann. Rep. Arkansas Geol. Surv,. for 1890 (1891), vol. ii., pp. 58–60.</ref> in the pulaskite of the Fourche Mountains, the chemical analysis of the rock indicates clearly that the felspar is not a normal orthoclase but a cryptoperthite or soda-orthoclase.

Calculations based upon the bulk analysis of the rock (p. 27), combined with the judged percentage of felspar present, would suggest that the mineral has a composition approximately as given in Column I. below:

	I.	II.
SiO_2	67.4	66.08
Al2O2	19.1	18.77
K_2O	7.3	7.68
Na_2O	6.8	6 54

This compositon compares closely with that usually assigned to cryptoperthite, and, for comparison, an analysis of cryptoperthite from Fredriksvarn, Norway, is given in Column II<ref>W. C. Brogger, Die Mineralien der Syenitepegmatitgänge der Südnorwegishen Augit-und-Nephelinsyenite, Groth's Zeit. fur Krystallographie and Mineralogie, 1890, Bd. 60, pp. 527, 528.</ref>

The most prevalent basic silicate is a pale green aegerine-augite which occurs in elongated prisms that have a maximum extinction of from 35° to 40° with the long axis, and are usually edged and terminated with pleochroic grass-green aegerine extinguishing at about 7°. Occasionally aegerine constitutes a whole crystal. The aegerine-augite is enveloped by the felspar and is clearly of early separation.

Another pyroxene, also of early generation, is represented by small yellow ochreous pseudomorphs that have a somewhat irregular outline, but often show traces of the prism and pinacoidal faces. They are somewhat elongated and, at first sight, might be taken to represent olivine, were not the characteristic angles those of pyroxene. While the exact nature of this mineral is obscure, I would suggest that it has been either a rhombic pyroxene or a monoclinic pyroxene of

enstatite-composition, the clino-enstatite of Wahl (cf. innimorite Chapter 25).

The other essential constituents of the rock are amphiboles, which are, for the most part, of later separation than the felspar, although they occasionally occur intergrown with the aegerine-augite. They are deeply coloured minerals, strongly pleochroic in various shades of blue-green, and brown, and occur as small somewhat irregular crystals between the felspars, on which they may be moulded, or in an ochreous residual material in which they assume a more idiomorphic habit.

The majority of the crystals are greenish blue, or greenish brown, with intense dispersion that renders it impossible to obtain a definite extinction in white light.

There is considerable variation in these amphiboles, both as regards colour and composition, often in one and the same crystal; and while the greater portion of them may be referred to the soda-amphibole arfvedsonite, those with indigo and yellowish tints partake more of the nature of riebeckite. A deep-brown hornblende with intense absorption occurs sparingly, and, as was suggested by Rosenbusch in the case of the Fourche Mountain ' granite' (pulaskite), is closely allied to Bragger's barkevikite.

The accessory minerals are magnetite and apatite. Both are of early separation and occur enclosed in the felspar, the magnetite as well-shaped regular crystals and the apatite as slender needles.

The rock in its alkaline character, and from the nature of its component minerals, is clearly allied to the nepheline-syenites, more particularly to the pulaskite of Williams.

Although the alumina-content is somewhat low, the presence of nepheline might be expected, but diligent search has failed to detect it, and there is none of the usual secondary minerals which would indicate its original existence in the rock. If it occurs, it must be present merely as a sporadic accessory.

Trachytic vent and sill of Bràigh a' Choire Mhòr

(Anal. IV.; (Table 7); p. 27).

The agglomerate is represented by two slides (S14334) [NM 5613 4334], (S14436) [NN 1878 7377]; the plug by three (S14335) [NM 5615 4341] [NM 5615 4341], (S14335a), (S14821a)); the sill by three (S17101) [NM 5541 4307], (S17102) [NM 5547 4303], (S17103) [NM 5576 4339]. The analysed specimen quoted on p. 27 belongs to the plug.

The plug is composed of a dark-grey, fine-grained, and somewhat splintery rock, weathering to a browner tint, and breaking with a rough surface, in one direction, and with a smooth satiny surface, in another. The smooth surface is due to the parallel arrangement of tabular felspars.

The microscope shows a plexus of orthoclase-crystals, tabular parallel to the plane of symmetry and usually twinned according to the carlsbad law. The spaces between the felspars are filled by a pale-green to yellow pyroxene (aegirine-augite), and soda-amphiboles that are strongly pleochroic in shades of indigo and yellow and are clearly allied to riebeckite. Pyroxenes and amphiboles are about equally represented.

The felspars are elongated in a positive direction, and are seldom more than 0.5 mm. in length. They are somewhat irregularly terminated, and their extinctions are often undulose. They are orientated in a manner indicative of flow.

The pyroxene occurs both within the felspar as granules and in the interstices as moulded grains; only occasionally, does it show a tendency towards idiomorphism and an elongation parallel to the vertical axis.

The amphiboles are always interstitial, and although the pleochroism is not so intense as in the typical riebeckite the colour-scheme is more or less the same.

Of accessory minerals, apatite in slender needles pervades the rock, while magnetite as small well-formed crystals is plentiful.

A transparent mineral of higher refractive index than the felspar occurs sparingly in the interstices. It appears to gelatinize with. acids and is possibly nepheline, but its identification is by no means certain.

The sill-portion of the little Bràigh a' Choire Mhòir complex, as represented by a moderately fresh specimen (S17101) [NM 5541 4307], is a grey-green fine-grained platy rock with brown-stained surface-films. The microscope shows it to consist of small infrequent phenocrysts of orthoclase and perthite in a typical trachytic matrix of little crystals of alkali-felspar arranged with good parallelism; between the felspars lie grains and prisms of grass-green aegerine-augite, occasional small pseudomorphs after olivine in iddingsite and chlorite, and scattered crystals of magnetite. In the decomposed portions, interstitial chlorite is more prevalent.

Ardnacross Trachyte (Rudh' an t-Sean-Chaisteil)

(Anal. III.; (Table 7), p. 27).

The Ardnacross Plug is a phonolitic trachyte represented by three slides (S15753) [NM 5475 5022], (S15756) [NM 5497 5027], (S15757) [NM 5503 5026].

The rock is pale to dark yellowish grey colour and of medium grain. It is typically non-porphyritic, and consists of a plexus of positively elongated felspars that are mostly twinned on the carlsbad plan but occasionally show albite-lamellation. The felspar-laths are soda-orthoclase and albite-oligoclase, and are arranged with a certain amount of parallelism according to the direction of flow, so that the resulting structure lies midway between the types known as orthophyric and trachytic. In some cases, the rock is traversed by narrow veins, probably primary, that contain idiomorphie crystals of water-clear analcite; but for the most part this mineral has an allotriomorphic habit, and occurs interstitially.

Fresh nepheline has solar not been detected but sharply bounded rectangular patches of analcite are present in certain portions of the rock and are presumably pseudomorphs after this mineral.

Ferromagnesian minerals are quite subordinate to felspar in quantity, and the only ones remaining in an unaltered condition are orange-brown biotite and to a less extent aegerine-augite. The biotite builds small somewhat ragged plates that occur interstitially and occasionally envelop the felspars in an ophitic manner. There are also small hexagonal pseudomorphs in chlorite after hornblende; the regular hexagonal form of such crystals as are cut perpendicular to the vertical axis is due to an equal development of prism and pinacoidal faces. Other similarly orientated small pseudomorphs have been noticed with the characteristic octagonal form of augite. The original nature of the hornblende cannot be determined, but it seems to have been a variety rich in iron. The augite, judged from a few grains that have escaped alteration, appears to thave been the alkaline aegerine-augite.

Of accesssory minerals, apatite and magnetite are both fairly prevalent. Apatite is especially abundant, and occasionally forms large crystals in the neighbourhood of the biotite. Generally speaking, the rock is fairly fresh, but here and there it has suffered a certain amount of decomposition resulting in the separation of interstitial calcite, chalybite, chlorite, and zeolitic minerals, and to a certain extent the analcitization and chloritization of the felspars.

The analysis given on p. 27, shows that the rock is more alkaline than the syenite of Gamhnach Mhòr which it resembles in some respects. Its high percentage of soda finds expression in the occurrence of a soda-felspar and analcite. It differs chiefly from the generality of trachytoid phonolites in the presence of biotite as the chief ferromagnesian mineral, a feature that allies it more closely to the trachytes.

Bostonites betweeen Ben More and Carsaig

The Rudh' a' Chromain bostonite exposed on the shore near Carsaig<ref>As explained under Field-Relations (p. 187), this sill is not shown on the one-inch Map.</ref> (Figure 45) is a fine-grained non-porphyritic grey rock similar to those from the type. locality of Marblehead, Massachusetts (S18475) [NM 5237 2031], (S18476) [NM 5237 2031], (S18477) [NM 5237 2031], (S18478) [NM 5237 2031], (S18479) [NM 5237 2031], (Figure 28)c.

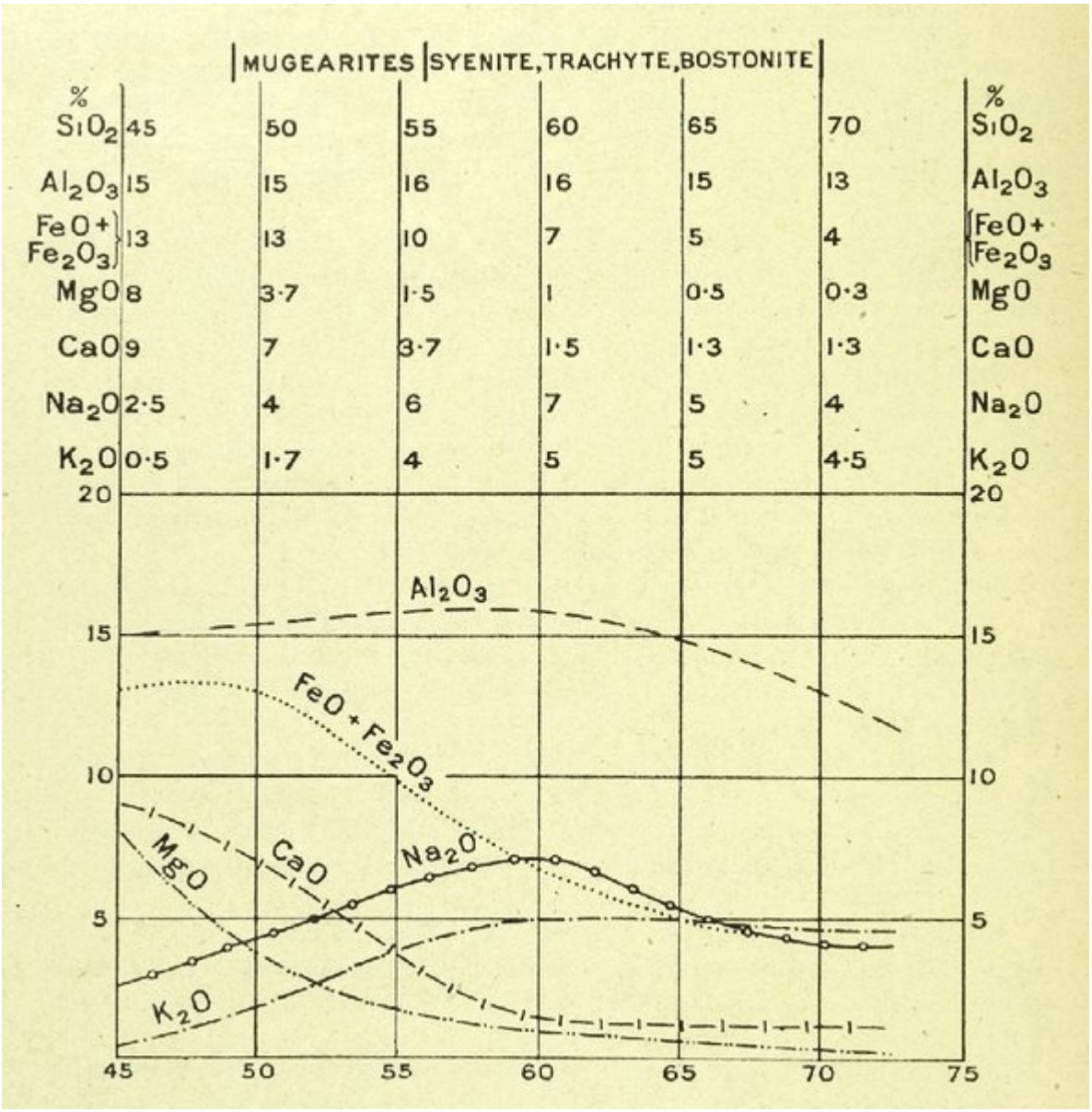
The sheet at Rossal Farm differs in being conspicuously porphyritic (S14898) [NM 5413 2775], (S16734) [NM 5410 2775], (S16692) [NM 5468 2720]. It is dove-grey in colour, compact and fine-grained, but its chief character is an abundance of dirty-white felspar-phenocrysts that average about 4 or 5 mm. in length but occasionally reach a centimetre. Under the microscope, the porphyritic felspars prove to be cryptoperthite (anorthoclase) with a narrow external zone of orthoclase, and the matrix to consist of a plexus of somewhat indefinitely bounded small crystals of orthoclase arranged with rough parallelism.

Ferromagnesian minerals appear to be practically unrepresented, but the matrix contains a good deal of greenish epidote, a fair amount of magnetite, and abundant apatite in the form of slender needles.

It is interesting to note that practically identical rocks were met with and described by Dr. Harker<ref>A. Harker, Tertiary Igneous Rocks of Skye, Mem. Geol. Surv., 1904, p. 289.</ref> from among the Tertiary minor intrusions of Skye, more particularly from the south-east of Elgol (S7485) [NG 522 139], and 350 yds. west-north-west of the north end of Loch na Creitheach (S7486) [NG 509 213]. These rocks were classed by him with the bostonites or bostonite-porphyries. The rock from Loch na Creitheach is identical in the hand-specimens with the Mull examples, but differs under the microscope in containing a small amount of fresh augite, a mineral so far undetected in the rocks under description.

An interesting rock (S17160) [NM 5346 3341], strikingly similar to the bostonites of Rossal Type in the hand-specimen, occurs 725 yds. east 32° north of Ben More summit, but is not shown on the one-inch Map. It exhibits the same texture and colour as the Rossal sheet and contains similar porphyritic crystals and glomeroporphyritic groups of cryptoperthite. A difference, however, which, if real, would appear to connect it with the trachytes rather than with the bostonites lies in the occurrence of a strongly pleochroic blue-green amphibole that builds small ragged crystals between the orthoclase-felspars of the matrix. This hornblende occasionally has the pleochroism and other properties of riebeckite; but, for the most part, the characteristic indigo-blue colour of this mineral is wanting and its place taken by shades of greenish-blue. There is no doubt that this rock belongs to the Rossal Type of intrusion, and it is not impossible that its amphibole may be a product of metamorphism.

H.H.T.



(Figure 4) Variation-diagram: Mull Alkaline Magma-Series.

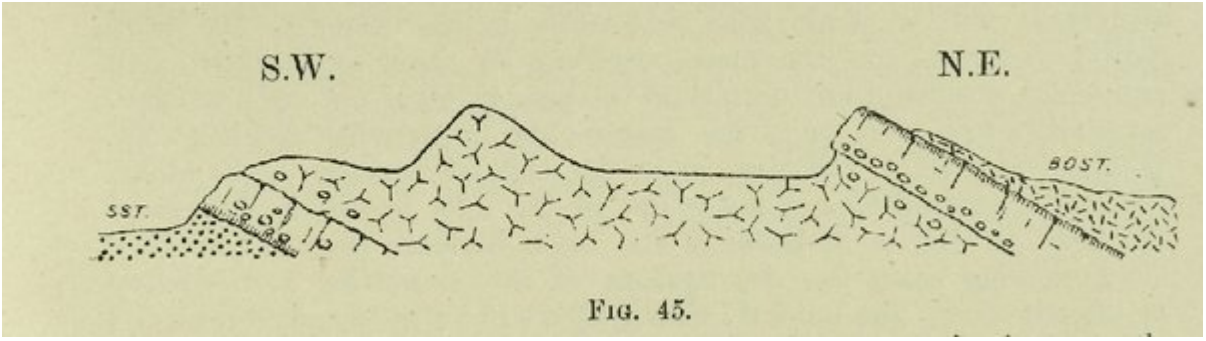


FIG. 45.

(Figure 45) Section at Rudh' a' Chromain across xenolithic composite sheet, showing external chilled margins against sandstone (SST) and bostonite (BOST). Quoted with minor alterations from Quart. Journ. Geol. Soc., vol. lxxviii, 1922, p. 234.

TABLE VII.—Alkaline Magma-Series of Fig. 4.

	Mugearite				Syenite	Trachyte		
	A	B	C	I.	II.	III.	IV.	
SiO_2	49·24	49·92	50·70	55·76	58·81	60·13	63·12	SiO_2
TiO_2	1·84	2·04	1·89	1·78	0·76	0·73	0·51	TiO_2
Al_2O_3	15·84	12·83	14·60	16·55	14·81	16·53	15·44	Al_2O_3
Cr_2O_3	tr.	tr.	..	...	...	...	...	Cr_2O_3
V_2O_3	...	0·04	...	...	...	...	...	V_2O_3
Fe_2O_3	6·09	6·96	5·23	3·10	4·58	2·86	1·73	Fe_2O_3
FeO	7·18	6·21	7·68	6·02	4·21	2·55	3·53	FeO
MnO	0·29	0·52	0·42	0·22	0·27	0·46	0·27	MnO
(Co,Ni)O	tr.	0·03	tr.	nt. fd.	nt. fd.	nt. fd.	nt. fd.	(Co,Ni)O
MgO	3·02	3·78	4·15	1·08	0·80	1·20	0·62	MgO
CaO	5·26	7·25	7·20	3·23	2·33	1·61	1·31	CaO
BaO	0·09	0·09	0·08	0·07	0·03	0·11	nt. fd.	BaO
SrO	tr.	tr.	tr.	...	...	...	...	SrO
Na_2O	5·21	3·72	3·71	6·28	5·60	8·06	5·81	Na_2O
K_2O	2·10	1·73	1·33	3·87	4·96	3·99	5·36	K_2O
Li_2O	...	tr.	? tr.	tr.	nt. fd.	tr.	nt. fd.	Li_2O
$H_2O+105°$	1·61	1·05	1·15	0·95	0·82	0·97	0·44	$H_2O+105°$
H_2O at 105°	1·08	3·58	2·08	0·80	2·00	0·55	0·14	H_2O at 105°
P_2O_5	1·47	0·45	0·49	0·40	0·20	0·57	0·25	P_2O_5
CO_2	...	nt. fd.	nt. fd.	0·03	...	...	1·89	CO_2
FeS_2	...	...	...	nt. fd.	nt. fd.	nt. fd.	nt. fd.	FeS_2
S	0·03	? tr.	nt. fd.	...	...	...	...	S
F	0·18	...	...	...	...	...	...	F
	100·46*	100·20	100·71	100·14	100·18	100·32	100·42	
Spec. grav	2·79	...	...	2·67	2·64	2·51	2·89	

(Table 7) Alkaline Magma-Series of Figure 4

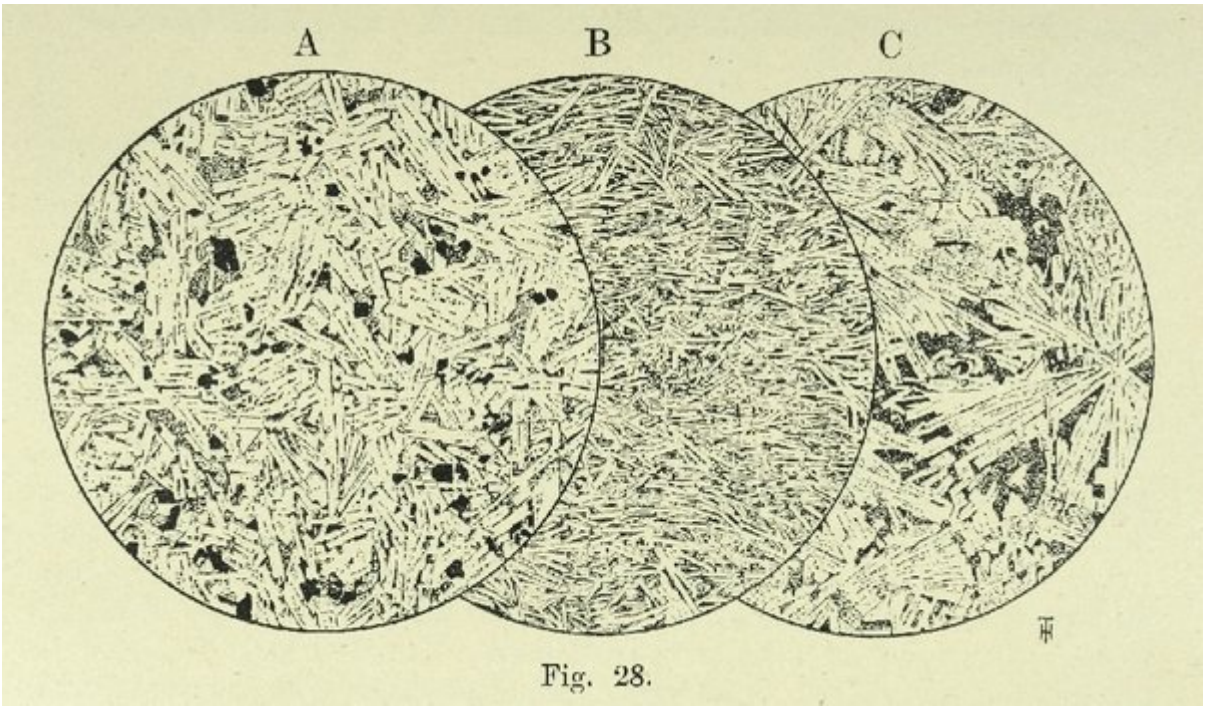


Fig. 28.

(Figure 28) A [(S15756) [NM 5497 5027]] ×15. Phonolitic Trachyte of Ardnacross (Rudh' an t-Sean-Chaisteil). Slightly elongated prisms of alkali-felspar, small plates of biotite, and a little magnetite, in a chloritized base. The rock contains a small amount of analcite-pseudomorphs suggestive of nepheline. B [(S14335) [NM 5615 4341] [NM 5615 4341]] ×15.

Trachyte of Bràigh a' Choire Mhòir. Small prisms of alkali-felspar arranged with some parallelism in a dark base largely composed of a green alkali-pyroxene and chlorite. C. [(S18477) [NM 5237 2031]] ×15. Bostonite of Rudh' a' Chromain. Prisms of alkali-felspar, often arranged in sheaf-like or radiate aggregates, in a dark-green chloritic base that contains some calcite and quartz.