CHAPTER V

Reydarfjor Acid Volcanic Succession

Stratigraphy - Third Phase

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(a) CENTRAL AREA

(i) Introduction

As in the two previous phases, the third was opened by explosive eruptions which resulted in the Third Phase Agglomerates and the equivalent bedded tuff horizon T_3. In the Breiddalur area and on the north side of Reydarfjordur the explosive eruptions were followed by the extrusion of about ten individual rhyolite lavas, though only three of these are ever present in any one section.

(ii) Agglomerates

In view of the close similarity of this deposit to the agglomerates of Phase Two, no detailed description is necessary. The agglomerates, which are estimated to be about 200 ft thick, are seen only in the two major branches of the Breiddalsa where they overlie the phase two rhyolites and are in turn covered by the phase three rhyolites.

Again a gradual change from acid to more basic activity can be noticed and there is some evidence that during the later more basic phase some thin basic lavas were produced.

To the east of Sodulhnjukur there is a small area of bedded acid tuffs, including a thin welded horizon, which overlie the eastern part of the Raudafell rhyolite. These may be the bedded equivalents of part of the Third Phase agglomerates. Alternatively they may have accompanied the extrusion of rhyolites of Phase Three

(iii) Rhyolite Lavas south of Reydarfjordur

At least six separate rhyolite lavas were erupted in the area south of Reydarfjordur during the Third Phase. Five of these occur in the same area as the agglomerates, while the sixth acid lava R_{3f} is interbedded within the flank succession. An additional flow, which outcrops only on the north side of Faskrudsfjordur, may also be part of the Third Phase. Of the Third Phase lavas, R_{3a}, R_{3b}, and R_{3c} must be regarded as approximately contemporaneous as they all lie directly on the phase three agglomerates and they are described first - then R_{3d} and R_{3e}, which are demonstrably later. Finally the case of R_{3f} will be described and its special features discussed.

(R_{3a}) This, the most northerly flow, occurs on the spur directly east of Sodulhnjukur, where it forms a prominent cliff about 100 yds long. In the field the flow would appear at a first glance to be continuous with one of a group of rhyolite lavas further down-dip to the south-west, but detailed petrographic examination has shown that this is not the case.

The rhyolite is porphyritic; the sodic plagioclase phenocrysts do not apparently show any preferred orientation and are set at random in a pale pink groundmass. Surfaces of the platy flow structure weather a characteristic pink.

The flow develops two very distinctive groups of structures. In one there is the normal development of platy flow structure with the usual large scale "swirls" or folds in the upper part of the flow; in the other the platy flow structure is completely absent, as also is any sign of streakiness, while the rock breaks with a

conchoidal hackly texture. It appears that this massive rock has not suffered deformation or attenuation during the formation of the major part of the flow.

The contacts between the hackly variety and the normal platy one are sharp and unchilled and in most cases parallel to the platy flow structure. The hackly variety appears to form sheets intruded along the platy flow structure and where this is horizontal, as at the base of the flow, these take on the appearance of normal irregular sills. (See photograph - fig. 26)

It is believed that the intrusion of the massive variety took place during the formation of the flow as auto-intrusions - hence the absence of chilling. Similar auto-intrusive features have been described from basic lavas.

(R_{3b})The scarp of R_{3b} is the lower of two conspicuous rhyolite cliffs on the south face of Sodulhnjukur. The flow is approximately 80 ft thick and in places almost the whole thickness is exposed, scree obscuring only the basal few feet. At the top of the flow the rhyolite is a near-black flinty rock, slightly porphyritic and very well banded. Small basalt xenoliths are quite common, although the main part of the flow is homogeneous, pale purple in colour, and in places quite massive.

Platy flow structure is variably developed, being conspicuous at the base of the flow but becoming less noticeable upwards. In general, the flow structure follows a well defined pattern from which it is possible to deduce that the lave flowed initially towards 120°

An auto-intrusive sheet in one of the Third Phase rhyolite lavas on the Southern Face of Sodulhnjukur.

Fig. 26.

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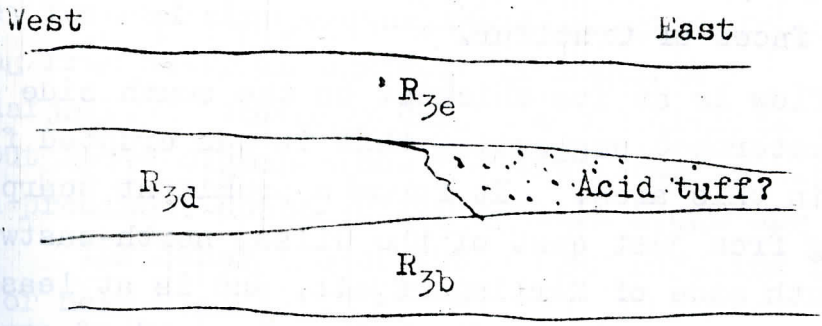
or 130°. Pressure ridges in the top of the flow are easily recognisable and are at right angles to the deduced direction of movement. At the base of the flow the platy flow structure is usually flat-lying and, if strongly developed, the feldspars have a preferred orientation, leading to the development of a lineation on the platy flow structure ("f" lineation).

It is thought that this "f" linear structure is preferentially developed in the basal section of the flow where the frictional drag is greatest. Observatio on R_{3b} support this hypothesis as the linear structure was only visible when the basal ten or fifteen feet of the flow were not obscured by scree. As this basal portion became hidden indications of the "f" structure became less and less obvious. Insufficient readings were obtained for statistical analysis.

(R_{3c}) Equivalent to R_{3a} and R_{3b} is a large and remarkably widespread rhyolite lava which occurs on the south side of Breiddalur. The most easterly exposures are north-east of Ljosarfjall, where the flow is 200 ft thick and forms a prominent scarp; it can also be found on the Baegsli ridge where it is at least 100 ft thick. Further to the east, however, above the Sela, the flow is probably much thinner and only 30 ft of rhyolite is actually exposed as the top and base of the lava are hidden by scree. Here the rock is grey, non-porphyritic and vesicular, and platy flow structure is weakly developed. Further to the west the flow is more massive and non-vesicular varieties occur. A marginal pitchstone does not appear tobe developed.

(R_{3d}) Directly below the large mass of white rhyolite on the north side of Breiddalur R_{3b} is directly overlain by a somewhat similar flow, R_{3d}, which is here about 80 ft thick, but of limited lateral extent, being absent directly south of Sodulhnjukur. This flow is bright pink and richly porphyritic, with plagioclase phenocrysts which have been stained by iron and are now pink. Platy flow structure is weakly developed and no preferred orientation of feldspar phenocrysts was noted. The base of the flow is not exposed, but the contact with the overlying flow R_{3e} can be made out at 1,200 ft.

(R_{3e}) Directly south of Sodulhnjukur R_{3e} is separated from the underlying flow, R_{3b}, by 30 ft. of scree which, it is thought, obscures a tuff bed of that thickness. But, as stated above, further to the west the two flows are separated by R_{3d} which thus forms a discontinuous wedge between them. The relationship between these three flows is shown below:-



This rhyolite flow is of particular importance as it has been taken as the flow showing the "ideal" pattern of folding of the platy flow structure. This is described

in detail in the appendix dealing with this topic ~~and details are also given of the statistical analysis of measurements made of the associated linear structures.~~

The flow is pale grey to purple and the surfaces of the platy structure are often stained bright pink. The base of the flow is not exposed, but rocks very near to the actual contact are not true pitchstones, but a hard, flinty, felsitic variety of rhyolite. The upper parts of the flow show a limited tendency to be brecciated.

The large scale of the folding in the platy flow structure leads to the limbs being very nearly planar surfaces; thus when the rhyolite fractures along these flow surfaces slate-like fragments are produced. Some of these are two or more feet in diameter.

(R_{3f}) The flow referred to as R_{3f} is a thick, non-porphyritic rhyolite lava which in places develops a true pitchstone. It occurs on both side of the Reydarfjordur/Faskrudsfjordur watershed on the north and south faces of Ornolfur.

The flow is at its thickest on the south side of the main watershed suggesting that it was erupted from a source in this area. It forms a prominent scarp stretching from just east of the Gilsa, north-eastwards to the south side of Kerlingarfjall, and is at least 150 ft. thick, the top 10 ft. being composed of strongly flow-banded pitchstone.

On the north side the flow is dark grey when fresh and very vesicular in places, with the vesicles contorted and stretched by viscous flow. It directly overlies R_{3c} at the western end of the exposure and is here about 40 ft thick. Traced eastwards and southwards it thickens, especially beyond the termination of the underlying flow R_{3c}, and can be followed towards Kerlingarfjall where it is cut out by a large fault.

The anomalous feature of this flow is its position away from the other rhyolite lavas of the Third Phase. It occurs in the middle of the third phase flank succession and is flanked by rhyolite andesite lavas. It is the only widespread rhyolite lava on the south side of the Vattarnes peninsula.

(iv) Rhyolite lavas north of Reydarfjordur

Four Third Phase rhyolites occur north of Reydarfjordur compared with six south of the fjord. Two of these flows (R_{3g} and R_{3h}) occur above Sellatur where they form an almost unbroken line of cliffs stretching from above Hognastadir to south of Helgustadafjall. Normally only one or other is present but above Sigmundarhus the two flows overlap to form a prominent double cliff between 1,000 and 1,200 ft. The other two of these four rhyolite lavas occur on or near Glamsauga.

(R_{3g}) The lower flow, R_{3g}, is about 100 ft thick below Helgustadafjall, although the base of the flow is never exposed. The rhyolite is a dark colour and weathers a pale brown. Throughout its thickness the flow is vuggy and uneven in texture and platy flow structure is only poorly developed. However, its two most

characteristic features are the large percentage of feldspar phenocrysts (these constitute over 15% of the bulk of the flow making it one of the most richly porphyritic rhyolites in the Reydarfjordur area) and the abundance of xenoliths. These are all of the same composition - a richly porphyritic basalt - and vary in size up to six inches in diameter. They are very irregular in shape and characteristically have crenulate margins. Some xenoliths appear in the field to show marginal chilling. They are randomly distributed throughout the rhyolite of the flow and its pitchstone top, and on average constitute 5% of the bulk of the flow.

(R_{3h}) To the west a second slightly porphyritic, greyish purple rhyolite flow, R_{3h}, rests on R_{3g}. This upper flow is 100 ft thick above Sigmundarhus, and rapidly increases in thickness down dip to about 300 ft thick above Sellatur. A flow breccia of pitchstone marks the base of the flow while the upper parts are black vuggy and massive. Platy flow structure is irregularly developed.

(b) THIRD FLANK SUCCESSION

(i) Introduction

The Third resembles the two earlier phases in that the eruption of a group of thin tholeiite and massive rhyolite andesite lavas took place simultaneously with eruptions of rhyolite in the Central Area. However, the third phase flank succession is markedly thicker than its second phase counterpart.

Unfortunately the tuff T_3 which marks the base of the Third Acid Phase is very impersistent, perhaps due in part

to contemporaneous erosion, as in the case of T_2. However, the top of the Third Phase is very clearly defined, especially on the Vattarnes Peninsula, by the base of a thick group of flood basalt lavas.

In three localities, the tuff T_3 is intimately associated with a very characteristic, large phenocryst, porphyritic basalt. This association greatly aids the correlation of the tuff horizons south of Faskrudsfjordur.

(ii) Kambanes Peninsula

On the south shore of Stodvarfjordur the bedded tuff T_3 and the associated large phenocryst basalt occur almost directly below Hvalnes. Here the succession which is almost certainly not complicated by faulting is:-

Phase Three	exposure gap	
	porphyritic basalt	Large phenocryst types.
	basic tuff	
	porphyritic basalt	
	acid tuff T_3	
Phase One	Vesicular porphyritic basalt	
	Three tholeiite lavas	

As noted earlier, the tuff T_2 and rocks of the Second Flank Succession are absent on the Kambanes peninsula and Phase Three rests directly on lavas of Phase One.

The exposures near Hvalnes make it difficult to estimate the thickness of any of the units, but the acid tuff must be at least 30ft thick and contains fragments of

rhyolite and basalt which are mostly smaller than ¾" but occasionally exceed 3 ins. Of the two over-lying porphyritic lavas, the upper is the slightly less porphyritic, and they are separated by a basic tuff containing large crystals of bytownite feldspar similar to those in the lavas.

The overlying flows of the Third Flank succession are very poorly exposed on the shore north-west of Hvalnes and are thought to consist almost entirely of tholeiite lavas, which are typically thin. They contain large amygdales bearing abundant quartz, calcite and chalcedony. A few more massive flows may perhaps represent incursions of flood basalts into the area. At least one porphyritic basalt also occurs; it is seen on the shore about 1/3 mile west of Alaugara. About 300 yds west of the Tofta more porphyritic basalt lavas appear, while higher up in the succession olivine bearing lavas are prevalent, the latter indicating that flood basalt volcanicity had become established in the Stodvarfjordur area.

On the south side of Stodvarfjordur this type of volcanicity persisted until the deposition of the olivine basalts of the Holmar Group over the whole of the Reydarfjordur/Faskrudsfjordur/Stodvarfjordur area and gave rise to about 4,000 ft. of porphyritic basalts, olivine basalts and tholeiites as well as a surprisingly large number of flows which show characters intermediate between typical tholeiite and olivine basalt.

(iii) Hafnarnes Peninsula

The lower part of the succession on the north side of Stodvarfjordur closely resembles the succession already described from the south side. The Acid tuff T_3 is

overlain by a large phenocryst porphyritic basalt and basic tuff, which is in turn overlain by a succession of thin tholeiite lavas. These are exposed on the shore for about half a mile east of the Vallara.

In the cliffs above the Selaekur the upper part of the overlying 700 ft of lavas is very well exposed. Most are tholeiites, but some of the upper flows become quite massive; the topmost nine flows here have a total thickness of 400 ft suggesting that they may in fact be flood basalts. Above the topmost tholeiite flow, and forming a very marked bench on the hillside at this point, is a thin porphyritic basalt with an associated basic tuff above it. This is the basal member of the porphyritic group recognised on the south side of the fjord, which here forms a less conspicuous part of the flood basalts above the Third Flank succession.

No exposures of the tuff T_3 have been found in the area north of Kirkjubol, but both T_2 and T_3 occur on the flat topped ridge near Thriklakkar. The conspicuous bench forming the summit of Leirufell has been produced by the erosion of T_3. The tuff itself which is only poorly exposed, is not associated with a large-phenocryst porphyritic basalt and is overlain by a series of tholeiite and porphyritic basalt lavas which are magnificently exposed on the Leirufell/Stodji ridge. Here 22 flows totalling 620 ft form a lower tholeiite group below a porphyritic horizon. Most of these flows are tholeiite but three are porphyritic basalts and comparison with the relevant parts of the succession down-dip to the north-west suggests that only the lower 12 thin tholeiite lavas totalling 300 ft should be referred to phase 3. The remainder, including three porphyritic flows, are

probably flood basalts unrelated to flank activity. In actual fact the picture may be very much more complicated than thisin that the two types may interdigitate.

In the neighbourhood of the Sandfell the succession is complicated by the intrusion of the Laccolith and only on the Sandfell-Vindfell ridge are the rocks of the Third Flank succession adequately exposed. Here about 900 ft of steeply dipping lavas can be seen overlying T_3, but only some of these lavas belong to Phase 3, as olivine basalts form the upper part of the succession, the latter being part of the flood basalt group overlying the Third Phase.

Third Phase lavas are only poorly exposed in the Eyrara, but they probably total about 200 ft and consist entirely of thin tholeiites.

(iv) Vattarnes Peninsula

On the shore south-west of Kjappeyri the Third Flank succession is entirely of tholeiite lavas which probably total 200 ft thick. 3/4 mile up-dip, along the line of the Kottur composite dyke, the succession includes one rhyolitic andesite lava 60 ft thick. In the Gilsa this same lava is 90 ft thick and probably 110 ft of tholeiites overlying the rhyolitic andesite lava and approximately 100 ft of lavas underlying this massive flow should be included in the Third Flank succession, making this group 300 ft thick. Up-dip this rhyolitic andesite is apparently laterally equivalent to the rhyolite flow R_{3f}, east of which there are further rhyolitic andesite flows. These lavas - there must be at least four flows - form the prominent cliffs around the

flat-topped summit of Kerlingarfjall. Erosion has removed all trace of the succession above the T_3 further east, except for three tholeiite lavas on Grakollur itself which cap the acid tuff.

On the north side of Kerlingarfjall rhyolitic andesite lavas are again present especially above the two rhyolites R_{3c} and R_{3f} where there are at least three sub-acid flows. Elsewhere on Kerlingarfjall the rhyolitic andesite lavas are interbedded with more basic tholeiite flows, while north-west of the Baegsli ridge there was apparently no intervening flank activity before the deposition of the flood basalts which everywhere south of Reydarfjordur overlie the central and flank lavas of Phase Three.

(v) North Side of Reydarfjordur

The stratigraphy of the upper part of the Reydarfjordur Acid Volcanic Succession is complicated by the lack of persistent mappable horizons. This is particularly so north of Reydarfjordur and here only the Seldalur tuffs (Walker 1959) form clearly defined stratigraphic markers. A more detailed description of these layers is given later, but it is important at this stage to understand their stratigraphic position.

The two thickest of the Seldalur tuffs were probably erupted at the close of the Third Phase. The evidence for this is that on Helgustadafell one of the tuffs overlies the Third Phase rhyolites, while further north, within the flank succession, the tuffs overlie Third Phase intermediate lavas and occur at the base of a thick sequence of thin tholeiite flows erupted during the fifth and sixth phases.

Tholeiites which were probably erupted during the Third Phase underlie the rhyolite R_3 in the area above Helgustadir and Sellatur, while further east third phase thin tholeiite lavas form the summits of Grakollur and Vindhals, where they overlie T_2. However, it is only in the Nordfjordur area that Third Phase lavas form a conspicuous part of the flank succession.

A considerable thickness of Third Phase lavas must underlie the Glamsauga rhyolite, but it is impossible to give even an approximate estimate of the thickness due to the absence of horizons limiting the first and second phases. However it is certain that this succession contains no rhyolitic andesite lavas and only a few basaltic andesite flows.

Further west in Oddsdalur, the intermediate lavas form a more important part of the succession. At 1000 ft there is a well bedded basic tuff layer some 15 ft. thick. It contains bytownite phenocrysts and rounded rock fragments averaging ½" in diameter, set in a tuffaceous groundmass. The tuff is followed by a group of six Third Phase intermediate lavas which total approximately 200 ft. This is part of the andesite group mapped by Walker (1959) One of these flows may be terms a "rhyolitic andesite", being distinguished from the more basic members of the group by the marked platy flow structure and the finer grain size.

These lavas may be traced into Seldalur where, between 600 and 730 ft, there are a series of about eight lavas including six basaltic andesite flows and a single intercalated acid (?) tuff. Directly overlying this group is the lowest of the two thick Seldalur acid tuffs.

On Bagall, the only other locality where the Third Flank Succession has been studied, no intermediate lavas occur below the Seldalur tuffs; instead there are at least two olivine basalts in a thin group of tholeiite lavas which also includes an unusually coarse, bright pink acid tuff. This contains pumice fragments up to three inches in diameter and is assumed to have been the product of an explosive eruption in the area to the north or west.

(vi) Discussion

Due to the rather poorly defined limits of the third phase it is possible to make only fairly general statements concerning its extent.

As the basal tuff T_3 is found only south of Reydarfjordur, it is reasonable to suppose by analogy with T_1 and T_2 that it was directed southwards from an explosive vent in the Breiddalur area, close to or within the present outcrop of Ag_3.

It has been shown that the flank succession associated with the two earlier phases formed an elongate lens of rock, the succession thinning rapidly east and west from a north south axis. Thinning northwards and southwards along the length of the lens is less rapid, but none the less clear. This distribution pattern probably applied also to the third phase. Three flows of rhyolitic andesite are seen on Kerlingarfjall (close to the axis) and only a single flow down-dip in Gilsardalur. A similar down-dip thinning is also apparent on the south side of Faskrudsfjordur, where the succession on the Sandfell-Vindfell ridge, close to the north/south axis, is probably thicker than in the Eyrara to the west.

Present day erosion allows examination only of the down-dip side of the lens, but on general grounds (Walker 1961) it is likely to thin up-dip as well. Thinning north and south along the axis of the lens is less marked but clearly demonstrable in Nordfjordur and Stodvarfjordur where the third flank succession never exceeds 200 ft. compared with a maximum of about 500 ft on the Vattarnes peninsula.

Thus it can be seen that although it is impractical to draw an isopachyte map for the third phase flank succession, limited observations and more general considerations suggest that it would resemble that drawn for the second phase (fig.25)

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