CHAPTER III

REYDARFJORDUR ACID VOLCANIC SUCCESSION

Stratigraphy

First Acid Phase

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(a) CENTRAL AREA

(i) Introduction

The periodicity of volcanism in the Reydarfjordur Acid Centre somewhat simplifies the stratigraphy, as the six phases recognised are broadly similar. The first may be taken as the type example. The arrangement is shown diamgrammatically overleaf (fig.6.)

In the central area two types of eruptions occurred, the earler being a violent explosive eruption which produced the First Phase agglomerates, and the bedded tuff T_1. Later, less explosive eruptions gave rise to a series of interbedded rhyolite lavas and tuffs which form a conspicuous group on the south side of Reydarfjordur. Here about nine individual lavas have been recognised although they are not all present in any one section. They are tabular in shape although very restricted in lateral extent, and vary greatly in thickness from less than 10 ft. to 200 ft.; 75 ft. might be taken as an average thickness. Traced eastwards the acid rocks interfinger with basic lavas of the flank succession and eventually die out altogether.

The flows on the south side of Reydarfjordur may be conveniently divided into two groups (a) Flows to the west and (b) Flows to the east, of Raudufell. (A large rhyolite plug dating from the second phase) Lavas in the two groups cannot be correlated; moreover, lavas in group (b) are interbedded with basic lavas of the flank succession.

On the north side of Reydarfjordur only two rhyolite lavas can be assigned to the First Acid Phase and these are interbedded in the flank succession. This suggests that during the first phase the centre of acid activity was well over towards the southern side of Reydarfjordur.

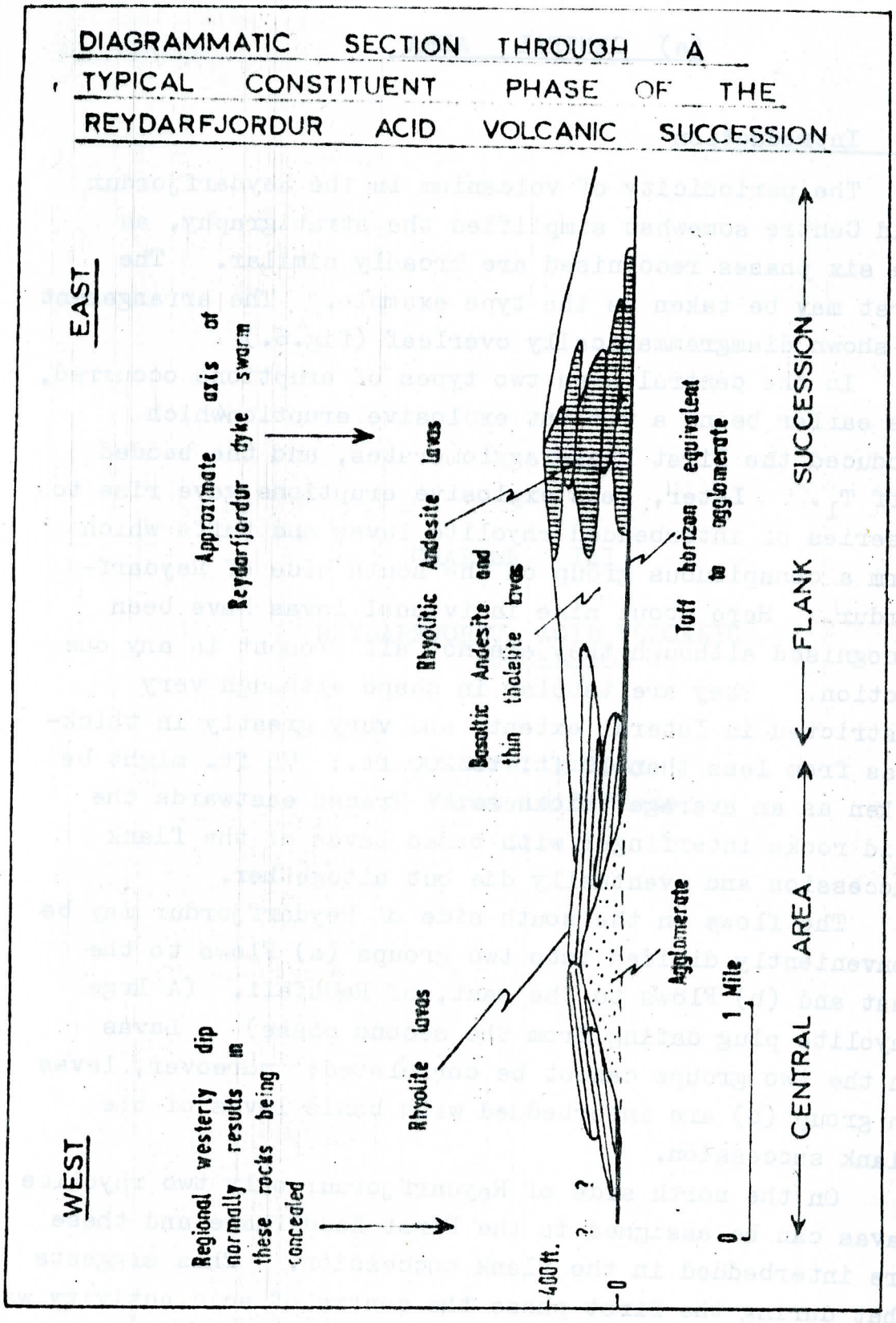

DIAGRAMMATIC SECTION THROUGH A TYPICAL CONSTITUENT PHASE OF THE REYDARFJORDUR ACID VOLCANIC SUCCESSION
EAST
WEST
Approximate axis of Reydarfjordur dyke swarm
Regional westerly dip normally results in these rocks being concealed
Rhyolitic Andesite Lavas
Basaltic Andesite and thin tholeiite lavas
Tuff horizon equivalent to agglomerate
Rhyolite Lavas
Agglomerate
400 ft.
0
1 Mile
CENTRAL AREA
FLANK
SUCCESSION

Fig. 6

(ii) First Phase Agglomerates

As noted above, the earliest products of the Reydarfjordur acid centre are a group of predominently acid agglomerates which are restricted to the south side of Reydarfjordur, where they outcrop around the farms of Eyri and Berunes. The base of the agglomerate is never exposed as the pyroclastic rocks form the core of the Thernunes uplift, but it seems likely that the agglomerates were deposited on top of normal flood basalts which occur stratigraphically about 300 ft above the top of the Vindhals porphyritic group.

The stream section in the Ytria reveals agglomerates almost continuously exposed from sea level to 520 ft. but it is very difficult to get any idea of the true structure of the deposit owing to the almost complete absence of bedding. In similar sections in the Eyrara and Berunesa bedding is again conspicuously absent. Most of the intervening ground between these streams is very poorly exposed, probably due to the friable nature of the agglomerate, while in the area around Eyri farm the structure is complicated by minor intrusions.

The acid agglomerate is pale green or brown and although unbedded the brown variety apparently always occurs at the top of the agglomerate succession and may be a stratigraphic variant, perhaps produced by a more basic phase in the eruption.

The rock fragments which make up a large proportion of the agglomerate are angular or poorly rounded and variable in size. Typically they range to 2 ins. in diameter with a preponderance of fragments between ½ inch and 1 inch, but rare boulders, usually of rhyolite and up to several feet across, also occur. The fragments are of rock types found elsewhere in the Reydarfjordur area and it seems likely that they were

produced by blasting out the vent.

In the Ytria a section at 400 ft. reveals a thin bed of boulders of tholeiite, many of which are 6 inches or more in diameter. This locality is the only one in which well defined bedding is seen, here inclined gently north.

The boulder bed is displaced by several small normal faults each with a throw of a few feet. More such faults may occur in the agglomerate but they are difficult to detect owing to the absence of marker horizons; slickensided fractures are common. Probably both the faults and the slickensided joints were produced by compaction of the unconsolidated agglomerate.

The absence of bedding and the size of the included rock fragments both point to the agglomerate having accumulated in or near the vent. As the agglomerates are always overlain conformably by younger lavas and are never seen cutting through older rocks, the latter alternative seems more likely. The deposit probably originally formed an agglomerate cone around the vent.

(iii) First Phase Rhyolite Lavas south of Reydarfjordur and west of Raudafell

(R_{1a})Overlying the first phase agglomerates in the Ytria is a rhyolite lava. The flow can only be traced to the east where it is seen below the fissure eruption on the spur north of Nontindur, although it is apparently absent in the Storadalsa.

The rhyolite is pink or pale grey in colour and non-porphyritic and develops at its base a very characteristic flow breccia. The fragments which make up this breccia can often be fitted together again, the rhyolite having been only slightly disturbed and fractured, probably by some late pulse of magma. Platy

flow structure is conspicuously developed and appears to be parallel to the base of the flow throughout its exposed thickness. Columnar jointing is also well developed and a cliff of columnar rhyolite is exposed in the upper part of the Ytria at about 600 ft.

(R_{1b}) Storadalsa Rhyolite. Above the first phase agglomerates in the Storadalsa, but separated from them by about 60 ft. of bedded tuffs, is a thick porphyritic rhyolite flow. The lava, one of the most continuous first phase rhyolites, can be traced for 1½ miles along the strike and appears to be uniform in composition with only slight changes in colour and texture. In the Storadalsa the flow is seen to have a basal selvage of black pitchstone, 3 ft. thick, which grades into normal rhyolite. Phenocrysts are present throughout the flow and constitute perhaps 10 per cent of the bulk of the rock, showing some tendency to cluster in aggregates. The phenocrysts are of sodic plagioclase and have a characteristic habit, being approximately square in cross section and markedly elongated parallel to $R_{1a}(a)$. The groundmass is fine grained, pink or grey in places and markedly vesicular, especially near the top of the flow. The rock does not show well developed platy flow structure and no tendency for the phenocrysts to develop a preferred orientation was noticed. However, poorly developed flow "joints" were observed and these are vertical at the top of the flow where a green pitchstone is irregularly developed. Due to the absence of true platy flow structure, the flow has a very massive appearance and tends to form very massive scree with conspicuously large blocks.

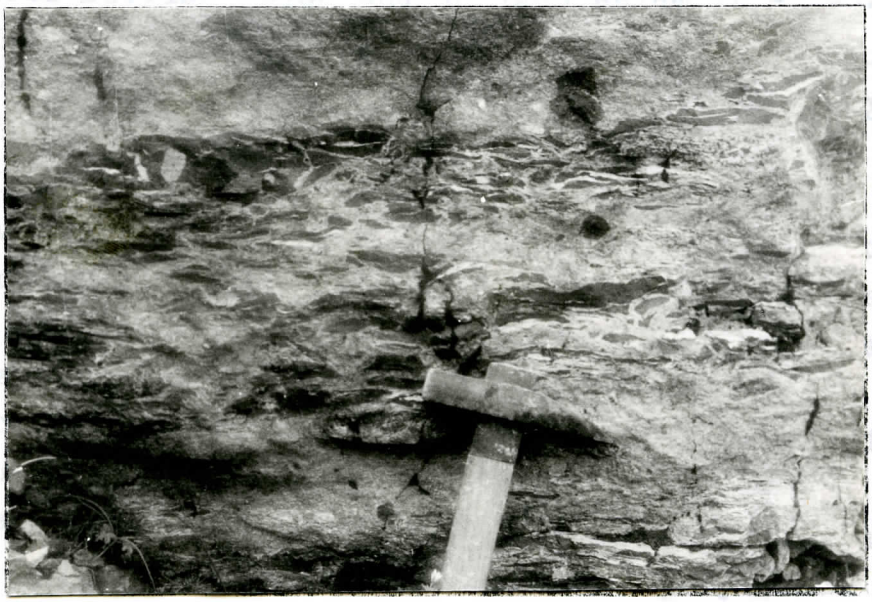
Although the flow is 200 ft.thick in the Storadalsa, west of here exposures are poor and the flow, which overlies R_{1a} cannot be followed further than the fissure eruption mentioned previously which definitely cuts it. East of the Storadalsa the pitchstone top of the flow can be traced across the lower slopes of Flatafjall to the next gully where the flow is 320 ft. thick. However, beyond this the large vent intrusion of Raudafell cuts out the flow and it is not found on the eastern side of this mass.

(R_{1c}) A thin rhyolite overlies R_{1a} in the Storadalsa gorge. Only 3 ft in thickness is exposed, both the top and bottom being hidden by scree and it is accordingly impossible to be certain that the rhyolite is extrusive. However in view of the relative scarcity of minor acid intrusives in the immediate vicinity, and the predominently extrusive rhyolite environment, this body is grouped with the other rhyolite lavas.

The small section of the flow exposed is of interest as it shows autobrecciation of the rhyolite. The main part of this exposure is pale yellow-brown in colour and contains occasional plagioclase phenocrysts and small rock fragments; this rock is intruded into a darker rhyolite and the fragments of this darker rock, although now separate, have only been moved apart and can easily be re-assembled (Fig.7.)

(R_{1d}) Flatafjall Rhyolite.

The flat topped hill of Flatafjall is composed of two rhyolite flows, the lower slopes being made up of the flow R_{1b} described above, while the summit of the hill is formed by a separate flow, R_{1d}. It is fine grained, slightly porphyritic (notably less so than R_{1b}) and shows strongly developed platy flow structure, as



Fragmental texture developed in a First Phase Rhyolite lava R_{1c}

Fig. 7

as a result of which most of the scree derived from this flow is composed of slate-like fragments which contrast strongly with the more blocky scree from the underlying flow. R_{ld} is probably about 300 ft. thick directly below the summit of Flatafjall but is of limited lateral extent, so that the mass might be classed as a low dome. It does not continue into the conspicuous gully that separates Raudafell and Flatafjall and is only 20 ft. thick in the Storadalsa where it overlies a thin acid tuff bed. This tuff may continue further east and if so would account for the inconspicuous bench which occurs between the Storadalsa rhyolite and the overlying Flatafjall rhyolite.

A small rhyolite plug occurs on the north east face of Flatafjall and the rhyolite of plug and flow are continuous. The plug is marked by a layer of black pitchstone round the margin, while the vertical platy flow structure in the neighbourhood of the vent has a marked vertical linear feature on its surface.

This flow is unusual in that it is one of the few first phase rhyolites to develop phenocrysts of anorthoclase, instead of the ubiquitous plagioclase. This suggests that this particular lava may in fact belong to the sixth phase, when other anorthoclase-bearing rhyolites were extruded.

(R_{le}) A large scree-covered mound of rhyolite occurs east of the Ytria. As exposures are very poor and the contacts with the surrounding agglomerates are always hidden by scree, the true field relations of this mass and two similar scree covered ridges, one north of the Storadalsa and the other east of the Berunesa, are unknown. Petrographic evidence suggests that these three masses are in fact part of the same body and that this is either a rhyolite flow in the agglomerates, or an intrusion.

(iv) First Phase rhyolite lavas south of Reydarfjordur and east of Raudafell

This group of lavas is exposed between Raudafell and Hrafnakambar in five conspicuous stream gullies. For ease of reference these have been numbered from one to five, working from west to east. (see fig. 8.)

(R_{1f}) The lowest rhyolite flow in this eastern group occurs between 620 and 640 ft. ingully 4 where it is seen to overlie five thin tholeiite flows. The exposures are poor but pitchstone was observed at both the upper and lower contacts. The flow is not present in gullies 3 and 5.

(R_{1g}) In gully 3 the lowest acid lava occurs between 680 and 700 ft. The flow is grouped with the rhyolites although the rock is dark and flinty and non-porphyritic and may, in fact, be a rhyolitic andesite. The platy flow structure in the lower part of the flow is parallel to the flow base but upwards it becomes irregular. The flow also occurs in gully 4 where it is separated fromthe flow described above (flow R_{1f}) by a 20 ft. tholeiite flow.

(R_{1h}) Pink Rhyolite.

The most conspicuous flow in the eastern group of acid lavas is a very conspicuous pink rhyolite which can be found inall the five gullies except the western part of gully 1 where it is cut out by the Raudafell vent. It thins from west to east, being over 200 ft thick in gully 1 and only 100 ft thick in gully 5. In two of the sections it definitely overlies a thin acid tuff but this is not present continuously beneath the lava.

Although pink on weathered surfaces, the fresh rock

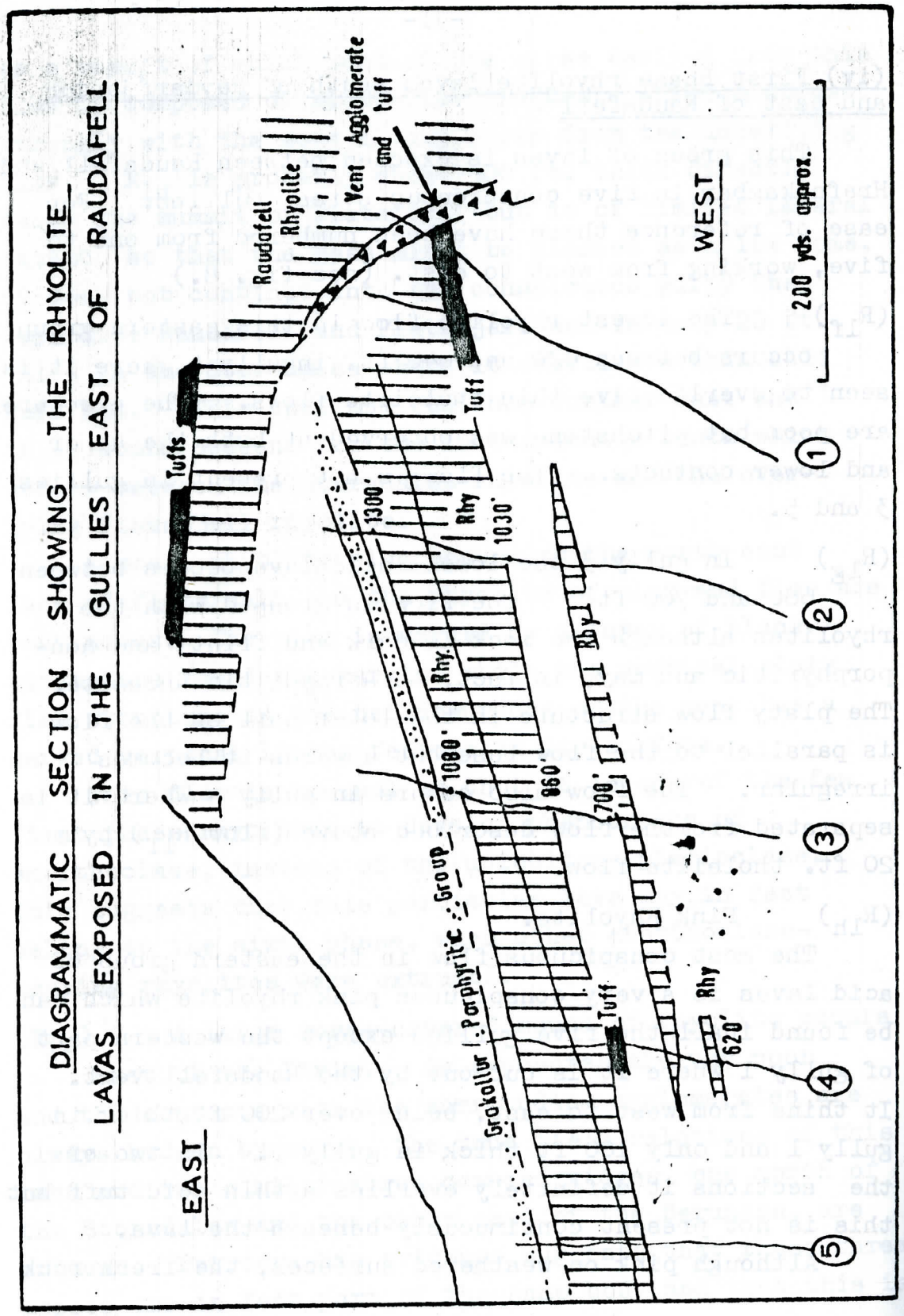

DIAGRAMMATIC SECTION SHOWING THE RHYOLITE LAVAS EXPOSED IN THE GULLIES EAST OF RAUDAFELL
EAST
WEST
200 yds. approx.
Raudafell Rhyolite
Vent Agglomerate and tuff
Tuffs
Tuff
1300'
Rhy
1030'
1080'
Rhy
860'
700'
Rhy
Grakollur Porphyrite Group
Tuff
Rhy
620'
1
2
3
4
5

Fig. 8

is grey, fine grained and slightly porphyritic. Platy flow structure is well developed and a study of this structure suggests flow down the dip, i.e. down the side of the supposed cone formed by the First Phase Agglomerates.

(R_{lj}) A less conspicuous, but none the less persistent flow of porphyritic rhyolite rests on the pink rhyolite, R_{lh}, which unlike the underlying flow can probably be traced east of the Hrafnakambar intrusion. Its thickness appears to vary from about 120 ft in gully 2 to 40 ft. in gully 4 and almost double that thickness in gully 5. A basal pitchstone is occasionally developed but there is no basal acid tuff, although a conspicuous bench marks the top of R_{lh}. Vesicles are abundant in the upper part of the flow where they are characteristically arranged in layers or bands parallel to the platy flow structure. The change from a vesicular to a non-vesicular rock can be very rapid and alternations between the two types frequently occur.

A rhyolite flow outcropping east of Hrafnakambar is thought to be a further part of R_{lj}, though some doubt about this exists. The rocks are certainly petrographically similar, although the vesicular variety is less common east of the intrusion. This eastern extension continues south of the farm of Thernunes as far as the Sela where it outcrops very near sea-level in a series of small streams which drain down to the beach here. In the Sela itself the base of the Rhyolite occurs at 180 ft above sea level, presumably on the upthrown side of an unexposed fault, the line of which must run just to the west of the Sela. Here the rhyolite is conspicuously dark in colour and resembles many of the rhyolitic andesites, but the phenocrysts of sodic plagioclase,

ferro-augite, and fayalite are typical of an Icelandic rhyolite. The rhyolite can be traced further east as far as the lower slopes of Hafranesfell where it is sandwiched between Porphyritic basalt lavas of the Grakollur group.

(v) First Phase Rhyolite Lavas north of Reydarfjordur

(R_{1k}) One only of the first phase rhyolite lavas occurs onthe north side of Reydarfjordur compared with eight on the south side. This single lava outcrops in the Helgustadaa between 400 and 680 ft. and is thus one of the thickest rhyolite lavas in the area. It is however very limited in lateral extent and does not outcrop on the short further west. The rhyolite, which is slightly porphyritic, is pale grey or brown and develops well marked platy flow structure. There is no basal pitchstone, but the rhyolite becomes glassy near the flow top.

The flow overlies tholeiite lavas of the First Flank Succession, and those directly above the rhyolite are porphyritic basalts of the Grakollur group.

(b) FIRST FLANK SUCCESSION

(i) Introduction

A group of basic and intermediate lavas were erupted at the same time as the First Phase agglomerates and rhyolites. These lavas can be traced over a wide area north and south of Reydarfjordur, and this widespread distribution contrasts strongly with the very restricted extent of the rhyolites and agglomerates of the Central Area. Due to the regional westerly dip the only flank lavas are seen up-dip or along the strike of the central

area (which is near sea level) and it is uncertain if a similar group is developed on the western down-dip side.

Correlation between the Central Area and the Flank Successions is effected by the use of bedded tuff horizons. The base of the First Phase Flank Succession is defined by the bedded tuff T_1 which is equivalent to the First Phase Agglomerates of the Central Area, while the tuff T_2, marking the onset of the second major acid phase, forms a convenient top. Unfortunately both tuffs are poorly exposed and somewhat impersistent which leads to difficulties in correlation. The diagrammatic stratigraphic sections overleaf show how, in the lower part of the acid succession, the tuff horizons have been used to effect correlation in areas where there are very rapid lateral variations in the stratigraphy.

(ii) Kambanes Peninsula

The peninsula south of Stodvarfjordur has a marked constriction near its eastern end, perhaps caused by erosion along the line of the tuff T_1. Unfortunately glacial drift obscures the relevant exposures on the north side of the Kambanes Peninsula, but on the south side there are two thin tuff horizons, separated by a single tholeiite flow. Probably only one of these is T_1 (the lower?); the other, not found on the Hafnarnes Peninsula, was probably the produce of an explosive eruption outside the Reydarfjordur Acid Volcanic Centre.

The lower tuff bed is about 8 ft thick, green in colour and noticeably fine-grained, particularly in the basal portion where fragments larger than ½ inch in diameter are rare. The upper is much thicker, being at least 30 ft. thick, though otherwise very similar in composition.

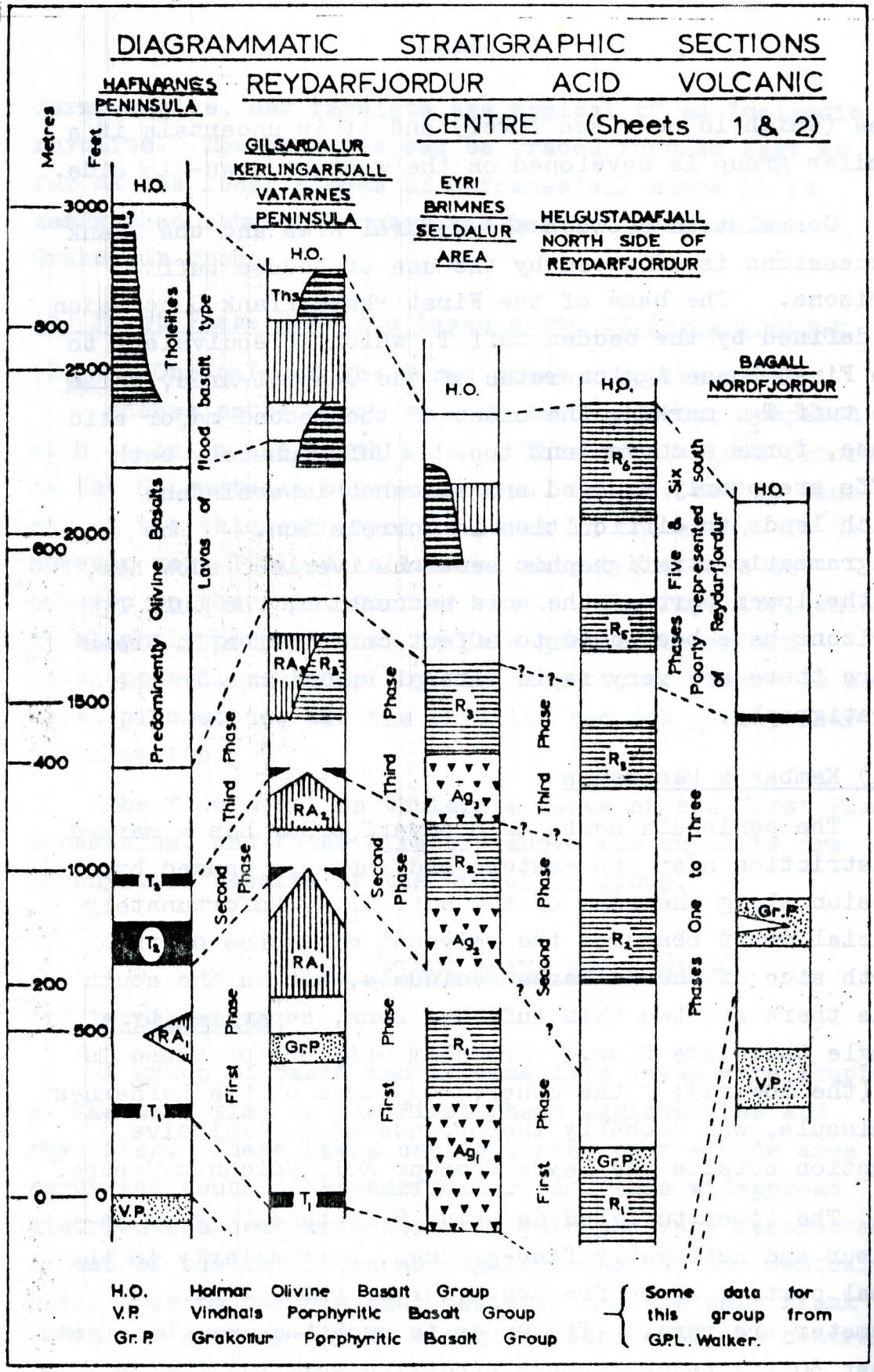

DIAGRAMMATIC STRATIGRAPHIC SECTIONS
REYDARFJORDUR ACID VOLCANIC CENTRE (Sheets 1 & 2)
HAFNARNES PENINSULA
GILSARDALUR
KERLINGARFJALL
VATARNES PENINSULA
EYRI
BRIMNES
SELDALUR
AREA
HELGUSTADAFJALL
NORTH SIDE OF
REYDARFJORDUR
BAGALL
NORDFJORDUR
Metres
Feet
3000
800
2500
2000
600
1500
400
1000
200
500
0
0
H.O.
Tholeiites
Predominently Olivine Basalts
Lavas of flood basalt type
Ths
RA3
R3
RA2
RA1
T3
T2
T1
V.P.
Gr.P.
Ag3
Ag2
Ag1
R6
R5
R4
R2
R1
First Phase
Second Phase
Third Phase
Phases Five & Six Poorly represented south of Reydarfjordur
Phases One to Three
H.O. Holmar Olivine Basalt Group
V.P. Vindhals Porphyritic Basalt Group
Gr.P. Grakollur Porphyritic Basalt Group
Some data for this group from G.P.L. Walker.

Fig. 9

Immediately overlying the tuffs on the north side of Breiddalsvik is a succession of tholeiite flows, the lower members of which are rich in quartz, calcite and chalcedony, these minerals often occurring in conspicuously large amygdales up to 18" in diameter. The higher parts of the succession are exposed on the south side of Stodvarfjordur, about half a mile east of Hvalnes where a series of tholeiites, some of which are fairly massive and over 40 ft. thick, directly underlie the Tuff T_2. Probably, on the Kambanes peninsula, the thickness of the flank succession equivalent to the First acid phase in the central area, is about 450 ft. and of particular interest is the occurrence on the north side of the peninsula, almost mid-way in the succession, of a single porphyritic basalt flow, the only equivalent in this area of the Grakollur Porphyritic Group, a group of lavas of considerable stratigraphic value on the Vattarnes peninsula.

(iii) Hafnarnes Peninsula

Exposures of the flank succession on the north side of Stodvarfjordur are very poor, the group occupying much of the drift covered ground in the neighbourhood of Kirkubol and the poorly exposed upper slopes of Thriklakkar. However, surprisingly, the basal tuff horizon, T_1, is quite well exposed. It is seen on the shore east of the town where it is now pinkish in colour and slightly coarser and thicker than south of Stodvarfjordur. Up dip it can be traced as a marked bench on the hillside. Further outcrops are seen at 300 ft and 580 ft. north east of Kirkjubol, and near the Merkigil at 1,000 ft. Over the whole of this area the dip is about 6° due west. On the main ridge below Thriklakkar (the top of which is composed of the acid tuff T_2) the

flank succession must be about 400 ft thick. Due to poor exposure the detailed composition of the group is unknown, though it is almost certainly entirely composed of basalt lavas which are probably largely tholeiite.

The ground on the south side of Faskrudsfjordur is slightly better exposed and a complete sequence through the first flank succession, here some 350 ft thick, occurs on the north face of Leirufell. A small fault cuts the face and the succession noted below is recorded from the eastern side.

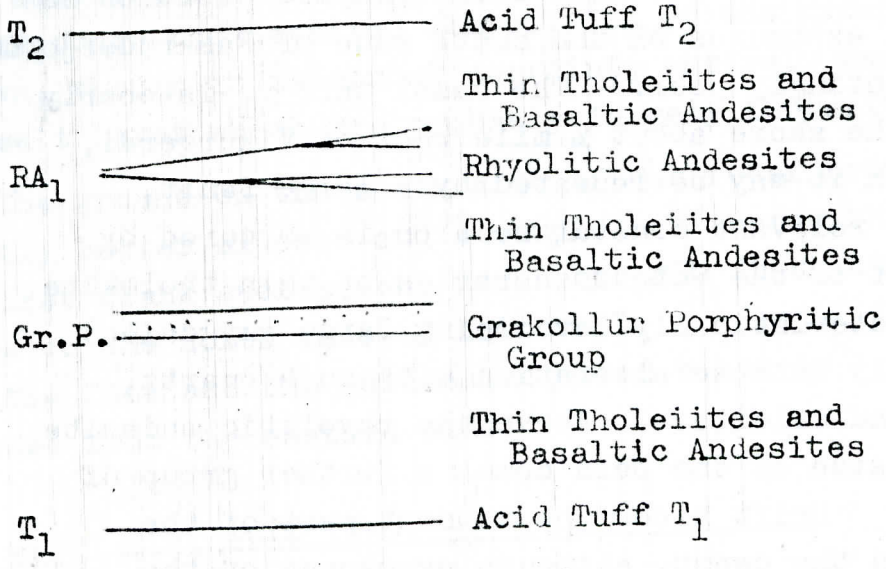
1340 ft.	Tuff (T_2)
	Five thin tholeiites
	Two massive Basaltic Andesites
1140 ft.	Weakly Porph. Tholeiite (Grakollur Porph. Group?)
	Five thin Tholeiites
1010 ft.	Tuff (T_1)

Traced down dip, just east of the Vikurgerdisa, a group of acid cills, offshoots from the Sandfell Laccolith, complicates the succession, while exposures north of the laccolith itself are very poor. However, it is in this ground that the first member of a very important part of the flank succession is found. This is a rhyolitic andesite lava (or doubtfully two lavas) lenticular in form and up to 100 ft thick, which outcrops on the coast to the west of the Sela and inland as far east as directly south of Vikurgerdi, although twice in this distance the line of the outcrop is broken by north-south faults. The rhyolitic andesite occurs in the upper part of the flank succession, although it

is difficult to fix its exact stratigraphic position as even coastal exposures on the south side of Faskrudsfjordur are disappointingly poor. The basal tuff T_1 is poorly exposed on the shore about ¼ mile west of Vikurgerdi, west of which it may be repeated by a large fault, although the relevant coastal section is obscured by drift. East of the Sela is a series of thin tholeiite lavas (characteristically developing large amygdales) showing fiarly intense alteration with much quartz, chalcedony and calcite. Above the rhyolitic andesite on the west side of the Sela comes a further group of tholeiites. Drift hides the topmost part of the succession on the coast, although exposures of the tuff T_2 near Eyri make it possible to estimate fairly accurately the position of the tuff on the shore. The width of the outcrop of the flank succession is here almost twice what it is on the north side of Stodvarfjordur, almost certainly due tothe group being that much thicker at the former locality. As will be seen this pattern of increasing thickness of the flank succession from south to north is continued on the north side of Faskrudsfjordur.

(iv) Vattarnes Peninsula

The first flank succession reaches its greatest thickness, probably approaching 1,500 ft, on the Vattarnes peninsula. It can be sub-divided into several smaller units and to clarify the description of this area a simplified stratigraphic table is given below:-



On the north side of Faskrudsfjordur the basal tuff, T_1, is exposed on the shore about 200 yds west of the mouth of the Haljara. Here it is about 40 ft. thick and dips to the west-south-west at 11°. A conspicuously coarse layer divides the tuff bed into two approximately equal portions which are otherwise fairly homogenous. The tuff is coarse with large pumice fragments up to 4 inches in diameter, which are conspicuously flattened. Rock fragments 2 to 3 inches in diameter are common and basalt predominates over rhyolite. The tuff is also exposed in the Heljara but otherwise exposures on the south side of Reydarfjordur are poor.

By far the best exposures occur on the main dividing ridge of the Vattarnes peninsula. About half a mile east of Soleyjartindur a small hill is capped by lavas of the Grakollur Porphyritic Group. The acid tuff, T_1, occurs 280 ft. below the base of these porphyritic lavas. Here it is finer in grain and much thinner, perhaps 20 ft. thick. As on the Hafnarnes

peninsula it is a conspicuous pink colour.

On the south side of the peninsula erosion along this horizon has produced a conspicuous bench and this can be followed down-dip almost to sea level if allowance is made for the displacement by the Grakollur fault. The tuff is not exposed on the south shore of Reydarfjordur but its most likely position is 1/3rd of a mile east of the farm of Hafranes, where there is a large shingle beach and bay, a conspicuous gap in the otherwise almost continuous line of low basalt cliffs.

The sequence between T_1 and the base of the Grakollur Porphyritic group contains only thin tholeiite lavas. In the Heljara the sequence totals 570 ft. while east of Soleyjartindur this is reduced to 280 ft. providing an extreme case of the up-dip thinning of lava groups noticed by Walker on the north side of Reydarfjordur (Walker 1959)

Grakollur Porphyritic Group.

This group of porphyritic lavas is generally poorly exposed on the Vattarnes peninsula, often being hidden by debris from the overlying lavas or by glacial drift, and outcrops only in stream gullies.

In the Villingaa occurs the most westerly outcrop of the group yet found on the north side of Faskrudsfjordur, and it is here restricted to one porphyritic basalt flow outcropping between 400 ft and 420 ft. Further west, where the group is cut by the Heljara fault, two flows together totalling 40 ft. are present. Just to the west of the Grakollur fault, the group is 130 ft. thick and consists of:-

Porphyritic Tholeiite----top at 980 ft.

Porphyritic Basalt

Porphyritic Tholeiite

Tholeiite

Porphyritic Basalt ------ Base at 850 ft.

On the south side of Soleyjartindur the group is just under a hundred feet thick and consists of:-

Porphyritic Tholeiite

Tholeiite

Porphyritic basalt — 90 ft.

Tholeiite

Porphyritic Basalt

Three richly porphyritic flows, with no intervening tholeiites and together totalling about 70 ft. form the top of a small hillock to the east of the east Soley-jartindur fault, this being the most easterly outcrop of the group.

On the north side of the Vattarnes peninsula, i.e. on the south side of Reydarfjordur, the group undergoes somewhat similar changes down the dip, although here the position is complicated by the occurrence on the lower slopes of Hafranesfell of one of the First Phase Rhyolites, which interfingers with the porphyritic group so that in the Sela one porphyritic lava occurs directly below the rhyolite and one overlies it, with the top at 300 ft. Further east the porphyritic lavas along with the attendant rhyolite are updomed by the Thernunes uplift, poorly exposed lavas of the porphyritic group occurring on the slopes north east of Hrafnakambar, while the most easterly exposures of the group consist of a single flow of porphyritic basalt about 20 ft. above the vesicular rhyolite in the ground between Hrafnakambar and Raudafell.

Usually the group is absent south of Faskrudsfjordur and only in two localities has a single porphyritic flow been recorded at the appropriate horizon.

Probably the most significant fact to emerge from the study of this thin stratigraphic unit on the Vattarnes peninsula is that the porphyritic basalt lavas as such are more common up dip and decrease in number as the group is traced westwards towards the eruptive centre for acid rocks, interfingering in this direction with tholeiite and rhyolite lavas.

The Upper part of the First Flank Succession.

The upper part of the First Flank Succession above the Grakollur porphyritic group on the Vattarnes peninsula is predominently composed of two contrasting lava types, massive rhyolitic andesite and thin tholeiite lavas, although intermediate types are also present. Generally they are well exposed, particularly on the north side of the peninsula, where the cliffed upper parts of Hafranesfell, Muli, Grakollur and Soleyjartindur provide ideal exposures.

From south to north the first instructive section is in the small stream above Brimnes. Poor exposures and the faulted nature of the ground make it impossible to examine the whole of the 1st phase here, but it seems certain that only one rhyolitic andesite lava occurs within the succession, the remaining flows being thin tholeiite or basaltic andesite.

In the Villingaa, 600 ft of lavas are exposed and these probably constitute all the upper part of phase one. Rhyolitic andesite lavas are here much more abundant, six lavas making up more than half of the exposed succession.

Still further east in the higher reaches of the Heljara, the group is still about 600 ft thick, but now contains only one rhyolitic andesite, while on the higher slopes of Sleyjartindur there are only 400 ft of lavas and rhyolitic andesite flows are completely absent - a firther example of rapid up-dip thinning.

Similar variations within the upper portion of the first flank succession have been mapped on the north side of the peninsula, though the rhyolitic andesite lavas are more conspicuous. Thus on Hafranesfell, 700 ft of lavas, including five massive rhyolitic andesite flows averaging

over 100 ft thick are seen. Further west, the thickness of the group is reduced and the number of rhyolitic andesite flows diminished, showing that here there is also rapid down-dip thinning.

(v) North side of Reydarfjordur

As was stated in the introduction, the distinction between "flank rocks" and lavas from the "central area" is only poorly defined north of Reydarfjordur. The rhyolite lavas tend to have intercalated tholeiites instead of agglomerate masses as on the south side of the fjord. Stratigraphic studies are further complicated by the fact that T_1, T_2 and T_3, well established south of the fjord, are probably absent north of the Reydarfjordur-Nordfjordur watershed. However the persistence of the Grakollur porphyritic group enables the areas on either side of Reydarfjordur to be correlated.

As will be seen, the flank succession as a whole thins drastically northwards so that a very much lower stratigraphic horizon, the Vindhals porphyritic group, becomes a useful marker on account of its continuous nature and characteristic appearance.

Few exposures of the tuff T_1 are found north of Reydarfjordur and it is absent north and west of Nontindur. It does not outcrop on the north shore of Reydarfjordur as the relevant coastal section is obscured by raised beach gravels, but just west of Utstekkur fragments of coarse bedded acid tuff are abundant and are almost certainly derived from nearby buried outcrops of the tuff. Fragments of silicified wood have also been found.

Only three other exposures of T.1 were found. At 1,080 ft. in the Kerlingara there is approximately 50 ft. of bedded tuff, the lower portion being dark in colour with a paler upper component. Further to the

east on Slettuskard the same tuff is 30 ft thick, the paler upper component being 10 ft thick and markedly reddened by Tertiary weathering. The most northerly outcrop of T_1 occurs about ½ mile north-west of Vindhals. Adjacent to the faultplane at 1,770 ft. there is about 30 ft. of tuff, again with only a thin acid portion.

It appears that the thick darker lower portion of the tuff T_1, found only north of Reydarfjordur, represents a separate eruption. This must have coincided with the production of the First Phase Agglomerates, although it is not suggested that the two portions of the tuff layer were produced from the same vent.

T_1 has been proved absent on Vindhalstindur, in Seldalur and Oddsdalur, and on Bagall. Conclusions derived from a study of T_1 are dealt with in the following section (vi).

The first flank succession between T_1 and the Grakollur porphyritic group north of Reydarfjordur, is entirely of tholeiite lavas. In the Reydarfjordur area these lavas are thin, and thick detrital horizons are either rare or completely absent. The flows exposed in Hrafnadalur are of this type.

Up dip the lavas become more massive, as on the north side of Vindhals, while even further east on Vindhalstindur the majority of the flows between the Vindhals and Grakollur porphyritic groups can be classed as normal flood basalts. The same may be said of the lavas within the same stratigraphic interval on Bagall, north of Nordfjordur and in Seldalur. As far as can be ascertained the change from thin tholeiite lavas to

flood basalts is progressive and there is no evidence that the flood basalts are banked up against a separate wedge of thin tholeiite flows.

Thickness variations within the group are rapid and spectacular. The following table gives the relevant information for localities where the thickness has been measured or can be accurately estimated.

Locality		Thickness of lavas between:- Tuff T_1 - and - Grakollur Porphyritic Group	Vindhals Porphyritic Group - and - Grakollur Porphyritic Group.
Hrafnadalur		1,000 ft	
S.face Vindhals		550	
N.face Vindhals		550	
Vindhalstindur	T_1 absent. Data obtained by extrapolation.	500	700 ft.
Oddsdalur		340	370
Bagall		230	300

The Grakollur porphyritic group is one of the porphyritic horizons mapped by Walker on the north side of Reydarfjordur (Walker 1959 p.378) However, the group is more widespread than is stated. On Vindhals and the eastern side of Grakollur the porphyritic horizon is represented by a single flow. When traced northwestwards

this lava does not die out but the outcrop is shifted by two large faults. Further outcrops of this porphyritic group can be found above the Vindhals porphyritic group on Skuggahlidabjarg, in Oddsdalur and Seldalur as well as on Bagall. At all of these localities the horizon is represented by two or three porphyritic lavas which may have intervening tholeiite flows.

In the neighbourhood of Grakollur and Vindhals, the Grakollur porphyritic group is directly overlain by a conspicuous group of Basaltic Andesite lavas - the Andesite group of Walker (1959). These intermediate lavas reach their maximum development on Vindhals where there are seven basaltic andesites and one rhyolitic andesite - the only lava of this type in the first phase north of Reydarfjordur.

Poor exposures of rhyolite on the ridge south west of Grakollur are probably small remnants of an outlying rhyolite from the central area.

As the intermediate lavas are traced north-westwards towards Oddsdalur, they terminate and are replaced by more basic flows - Intermediate first phase lavas being entirely absent in Oddsdalur and north of the Nordfjordara. Walker's (1959) map shows the andesite group as a continuous horizon extending into Oddsdalur. This is due to confusion with a stratigraphically higher group of Intermediate lavas which are well developed in Oddsdalur and Seldalur.

Only on Grakollur and Vindhals is the top of the First phase clearly defined by the presence of T_2, here some 400 ft. above the top of the Grakollur porphyritic group. Further north it can be inferred that the thickness of lavas overlying the Grakollur porphyritic group and erupted before the deposition of T_2 is much less, probably not exceeding 100 ft.

(vi) Discussion

The first phase is in many ways typical of the six phases which constitute the Reydarfjordur Acid Volcanic Succession. For this reason this phase has been treated in considerable detail; while conclusions based on a study of this group have an important bearing on the elucidation of the acid centre as a whole.

It has been noted that volcanic episodes are often opened by explosive activity producing tuff or agglomerate. It is therefore not surprising that the earliest first phase acid eruptions in the Reydarfjordur area were explosive. It is thought that these initial eruptions gave rise to the first phase agglomerates and the tuff layer T_1. However, direct petrographic evidence for the correlation of these deposits is lacking, although T_1 is the only extensive tuff layer occurring in the right stratigraphic position, i.e. between the Vindhals and Grakollur porphyritic groups.

T_1 is the first tuff horizon in Eastern Iceland which has been mapped all along the length of its outcrop and the probable source of which is known. The distributional pettern is therefore of considerable interest. As can be seen from the isopachyte map (fig.10) the tuff was probably regularly distributed and originally formed a continuous sheet. The original extent that can be directly inferred from observation is 50 sq. miles, but it seems likely that the tuff covered more than twice this area - a large portion of the bed occurring between basalts now below sea level. The thickness varies from 5 to 40 ft. and the total volume is estimated to be approximately ¾ cubic mile. The elliptical nature of the isopachytes is thought to be due to dispersal by strong north-westerly winds.

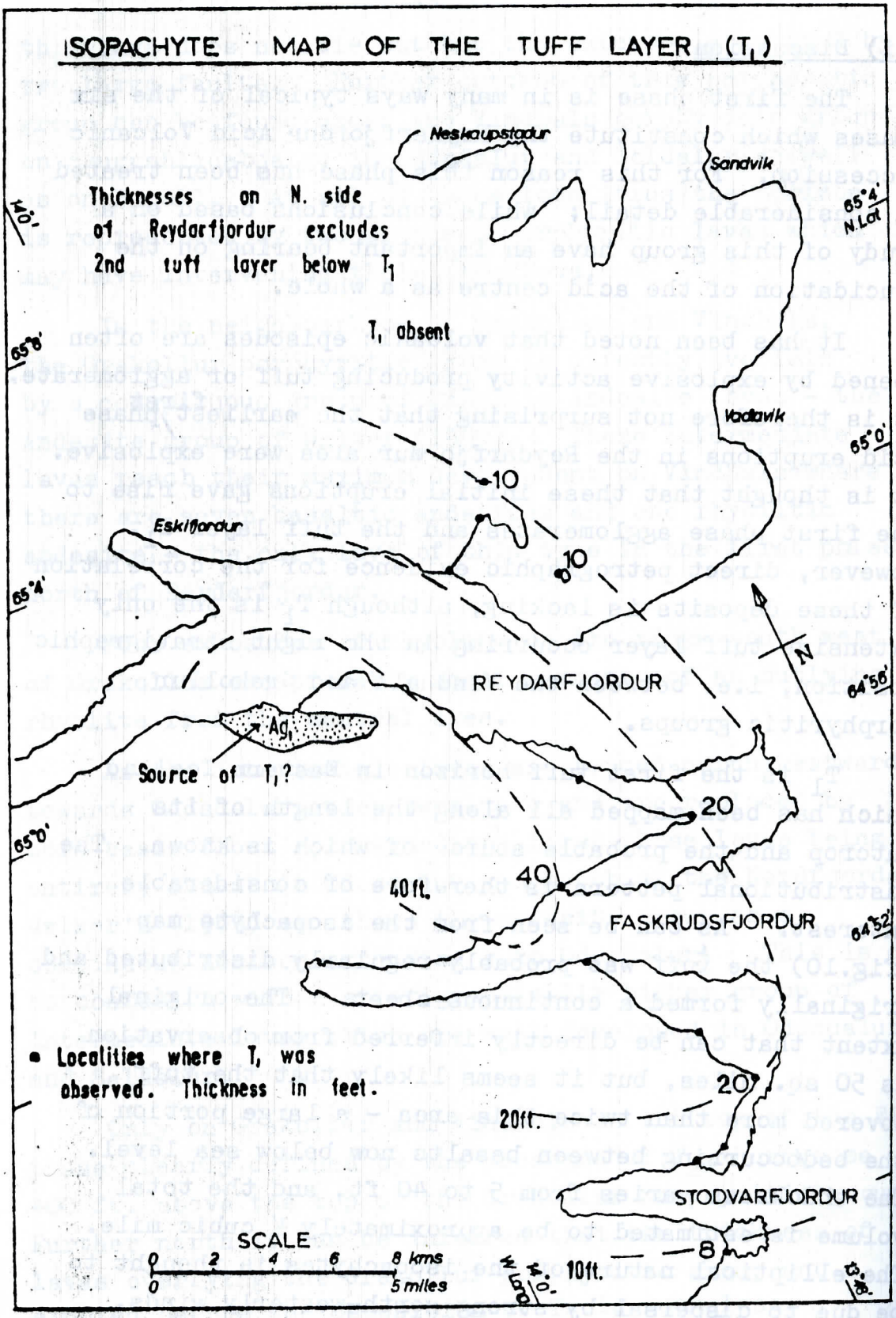

ISOPACHYTE MAP OF THE TUFF LAYER (T_1)
Neskaupstadur
Sandvik
65°4' N.Lat
Thicknesses on N. side of Reydarfjordur excludes 2nd tuff layer below T_1
T_1 absent
Vadlavik
65°0'
10
Eskifjordur
10
65°4'
N
REYDARFJORDUR
64°56'
Ag_1
Source of T_1?
20
65°0'
40
40ft.
FASKRUDSFJORDUR
64°52'
• Localities where T_1 was observed. Thickness in feet.
20
20ft.
STODVARFJORDUR
8
SCALE
0 2 4 6 8 kms
0 5 miles
10ft.

Fig. 10

It was a study of the first phase which led to the separation of the central and flank areas as two contrasting regions of volcanicity, as shown in fig.11. This eruptive pattern did not appear to indicate a strato-volcano of the type envisaged by Walker (1963) as active later in the Tertiary in the Breiddalur area. Therefore a detailed study was made of the upper part of the first flank succession in the hope that this would lead to an understanding of the nature of the volcanicity (figs.12 and 13)

It was found that rhyolitic andesite lavas do not occur at any one horizon but are preferentially developed almost throughout the upper part of phase one along a north/south line passing through Hafranes. In fact the rhyolitic andesite lavas may be likened to an acid-intermediate "facies" occurring within a more basic series of rocks.

It is possible to draw an isopach map for the thickness of this acid facies and this is shown in fig. 14.

As can be seen, at its thickest, along the north/south axis, over 500 ft. of rhyolitic andesite lavas are present, while there is a rapid diminution in the thickness to the east and west. There is a less rapid decrease in the thickness of the facies to the north and south, along the axis of the lens.

Little significance was attached to this distribution pattern until it was discovered that isopachyte maps drawn for the whole of the ~~first~~ stratigraphic interval $T_1 - T_2$ (fig.15) of for any part of it, e.g. T_1 - Gr.P. (fig.16) and Gr.P. - T_2 (fig.17.) follow a similar pattern.

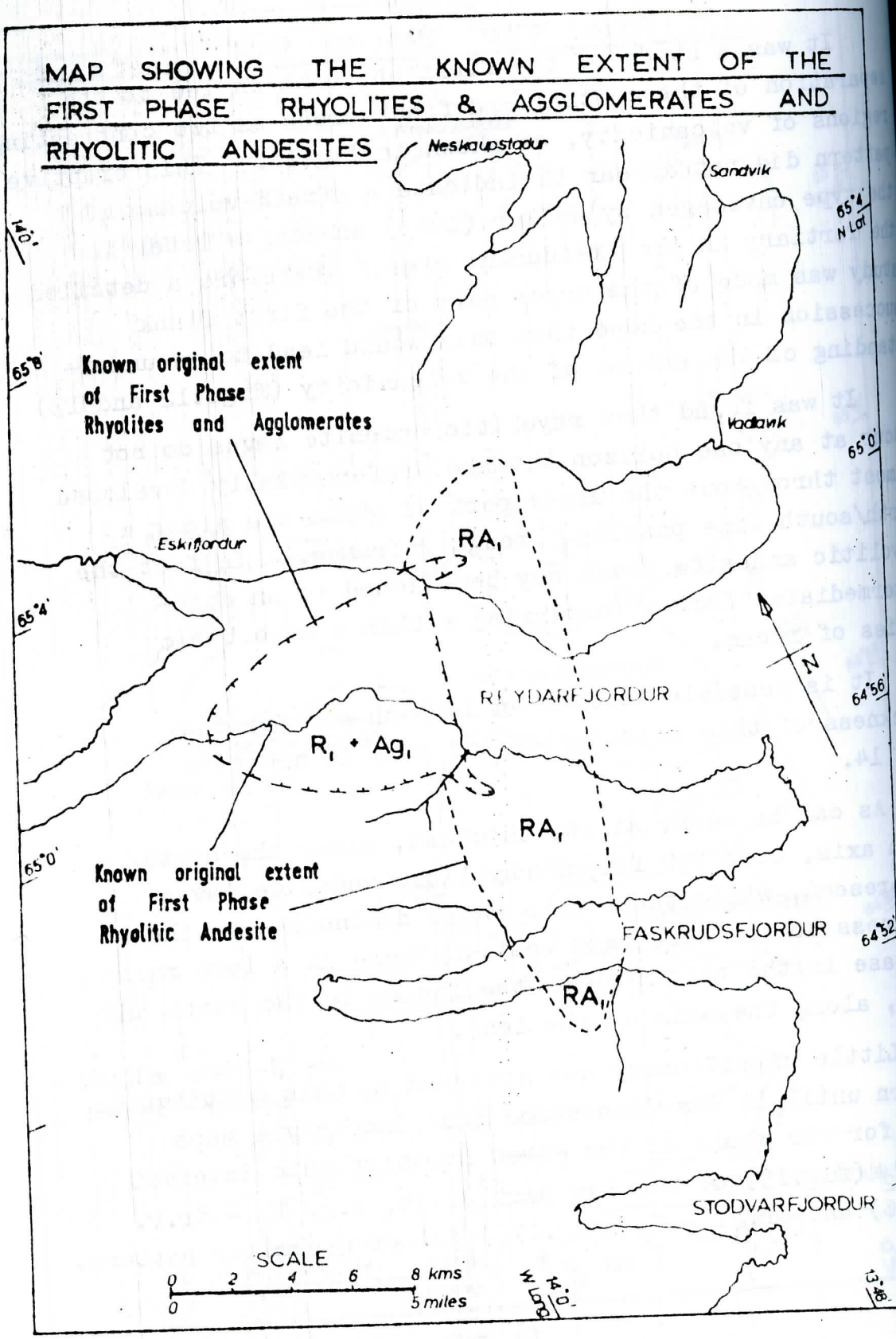
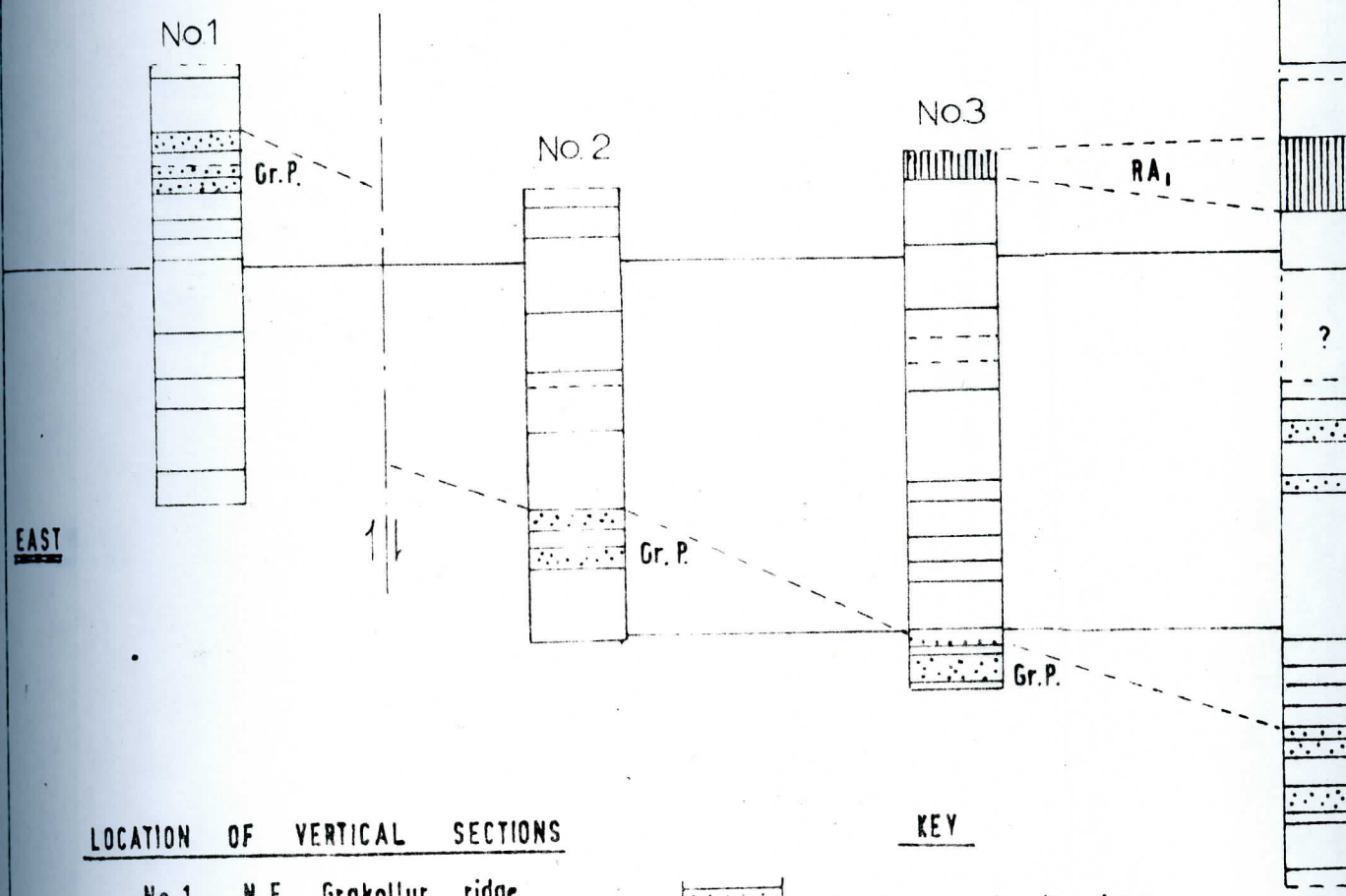

MAP SHOWING THE KNOWN EXTENT OF THE FIRST PHASE RHYOLITES & AGGLOMERATES AND RHYOLITIC ANDESITES
Neskaupstadur
Sandvik
65°4' N Lat
14°0'
65°8'
Known original extent of First Phase Rhyolites and Agglomerates
Vadlavik
65°0'
Eskifjordur
RA1
65°4'
N
64°56'
REYDARFJORDUR
R1 + Ag1
RA1
65°0'
Known original extent of First Phase Rhyolitic Andesite
FASKRUDSFJORDUR
64°52'
RA11
STODVARFJORDUR
SCALE
0 2 4 6 8 kms
0 5 miles
14°0' W Long
13°48'

Fig. 11

REYDARFJORDUR (South Side)



LOCATION OF VERTICAL SECTIONS

No. 1	N.E.	Grakollur ridge
No. 2	N.W.	Grakollur ridge
No. 3	N.E.	Muli ridge
No. 4	N.W	Muli ridge
No. 5	E.	Hafranesfell
No. 6	W.	Hafranesfell
No. 7	Sela	and above

KEY

- Porphyritic basalt lavas
- Tholeiite & Basaltic andesite lavas
- Rhyolitic andesite lavas
- Rhyolite lavas
- Section obscured by scree
- Position of contact determined
- Position of contact estimated
- Gr.P. Grakollur Porphyritic group

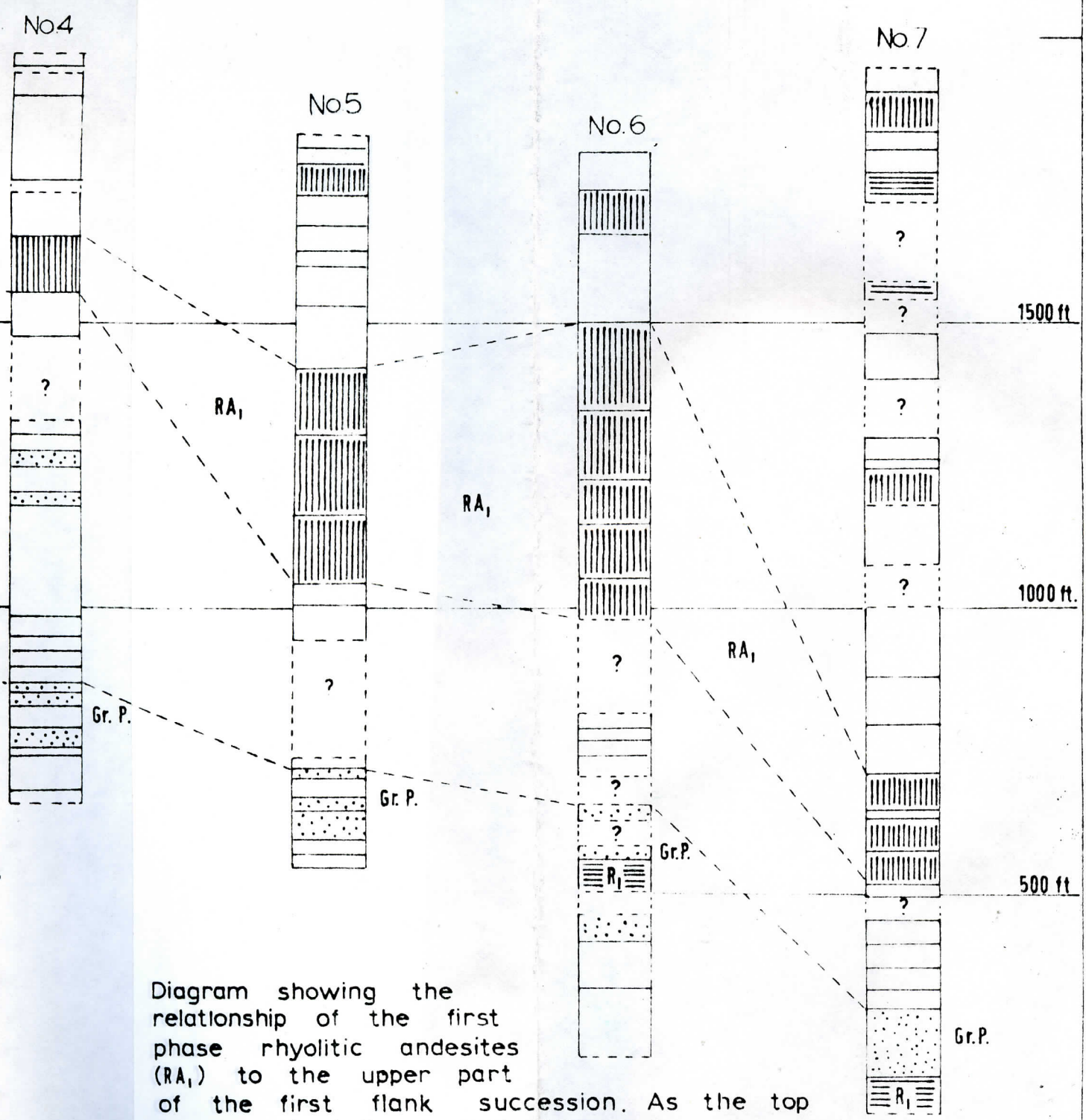


Diagram showing the relationship of the first phase rhyolitic andesites (RA_1) to the upper part of the first flank succession. As the top of the Grakollur porphyritic group represents a 'time - bedding' plane, the limits of RA_1 are obviously diachronous in places.

Fig. 12

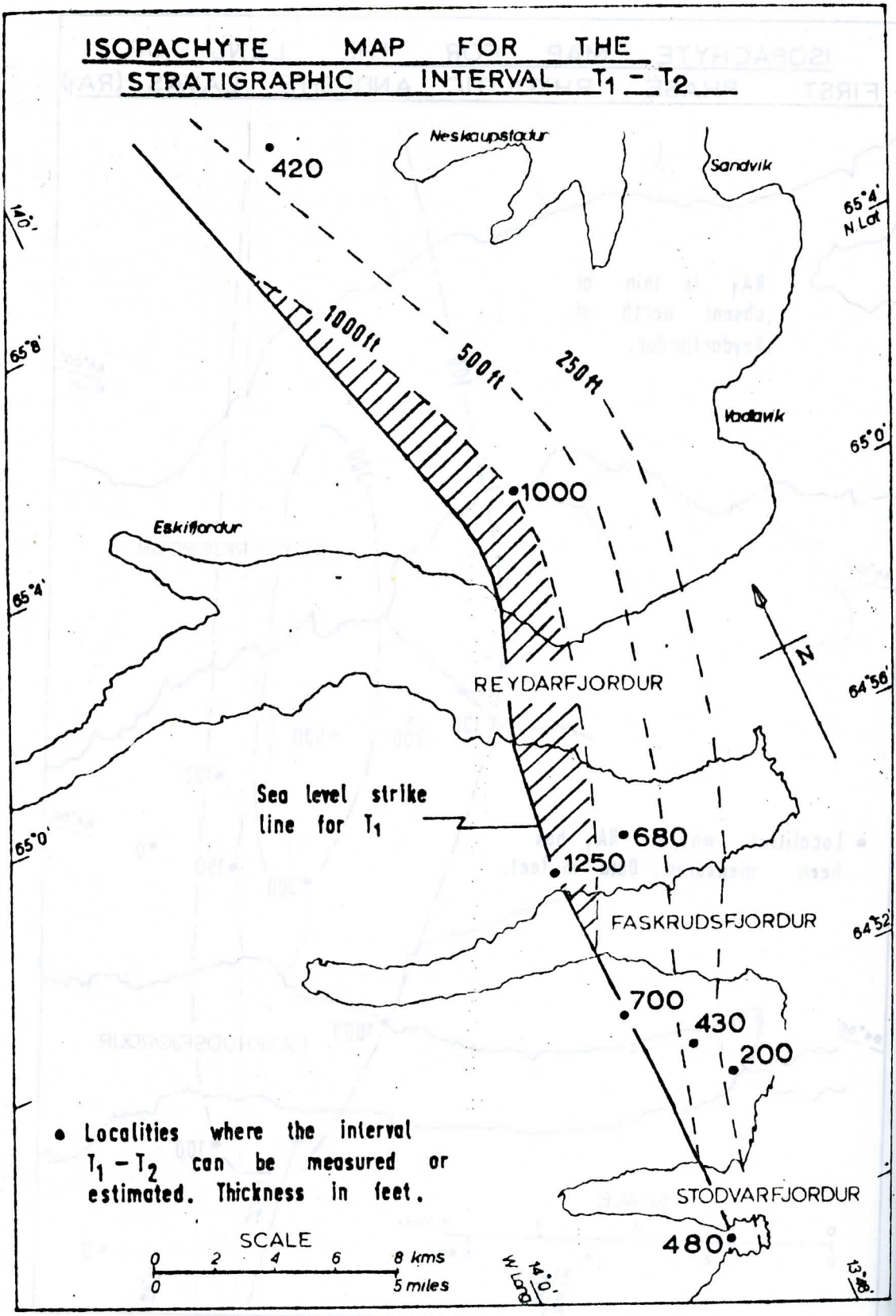

ISOPACHYTE MAP FOR THE STRATIGRAPHIC INTERVAL $T_1 - T_2$
Neskaupstadur
Sandvik
420
1000ft
500ft
250ft
Vadlavik
1000
Eskifjordur
REYDARFJORDUR
N
Sea level strike line for T_1
680
1250
FASKRUDSFJORDUR
700
430
200
STODVARFJORDUR
480
• Localities where the interval $T_1 - T_2$ can be measured or estimated. Thickness in feet.
SCALE
0 2 4 6 8 kms
0 5 miles
65°4' N Lat
65°0'
64°56'
64°52'
14°0' W Long
13°48'

Fig. 15

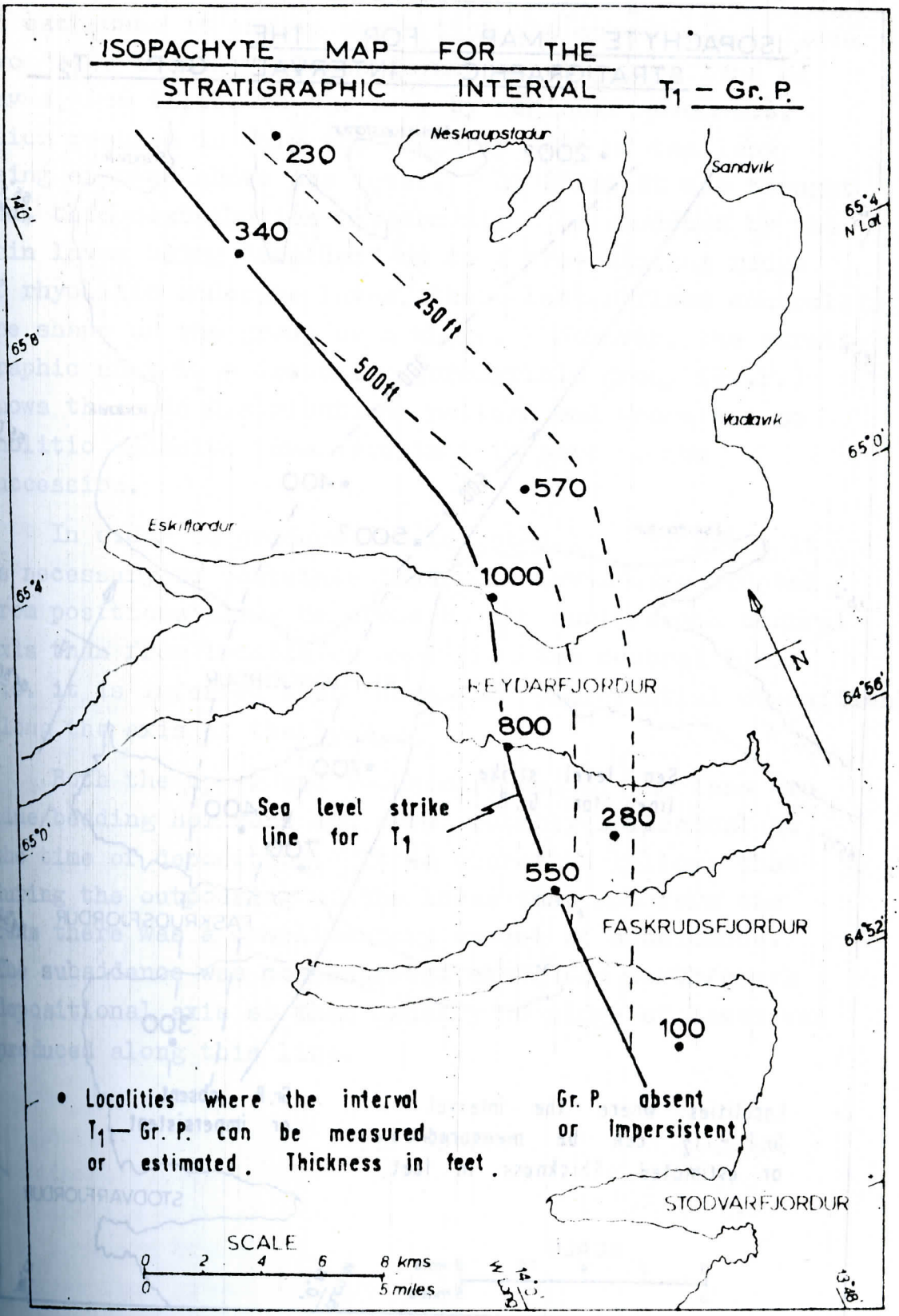

ISOPACHYTE MAP FOR THE
STRATIGRAPHIC INTERVAL T1 — Gr. P.
Neskaupstadur
Sandvik
Vadlavik
Eskifjordur
REYDARFJORDUR
FASKRUDSFJORDUR
STODVARFJORDUR
230
340
250 ft
500ft
570
1000
800
280
550
100
N
Sea level strike line for T1
• Localities where the interval T1 — Gr. P. can be measured or estimated. Thickness in feet.
Gr. P. absent or impersistent
SCALE
0 2 4 6 8 kms
0 5 miles
65°4' N Lat
65°8'
65°0'
65°4'
64°56'
64°52'
14°0'
14°8'

Fig. 16

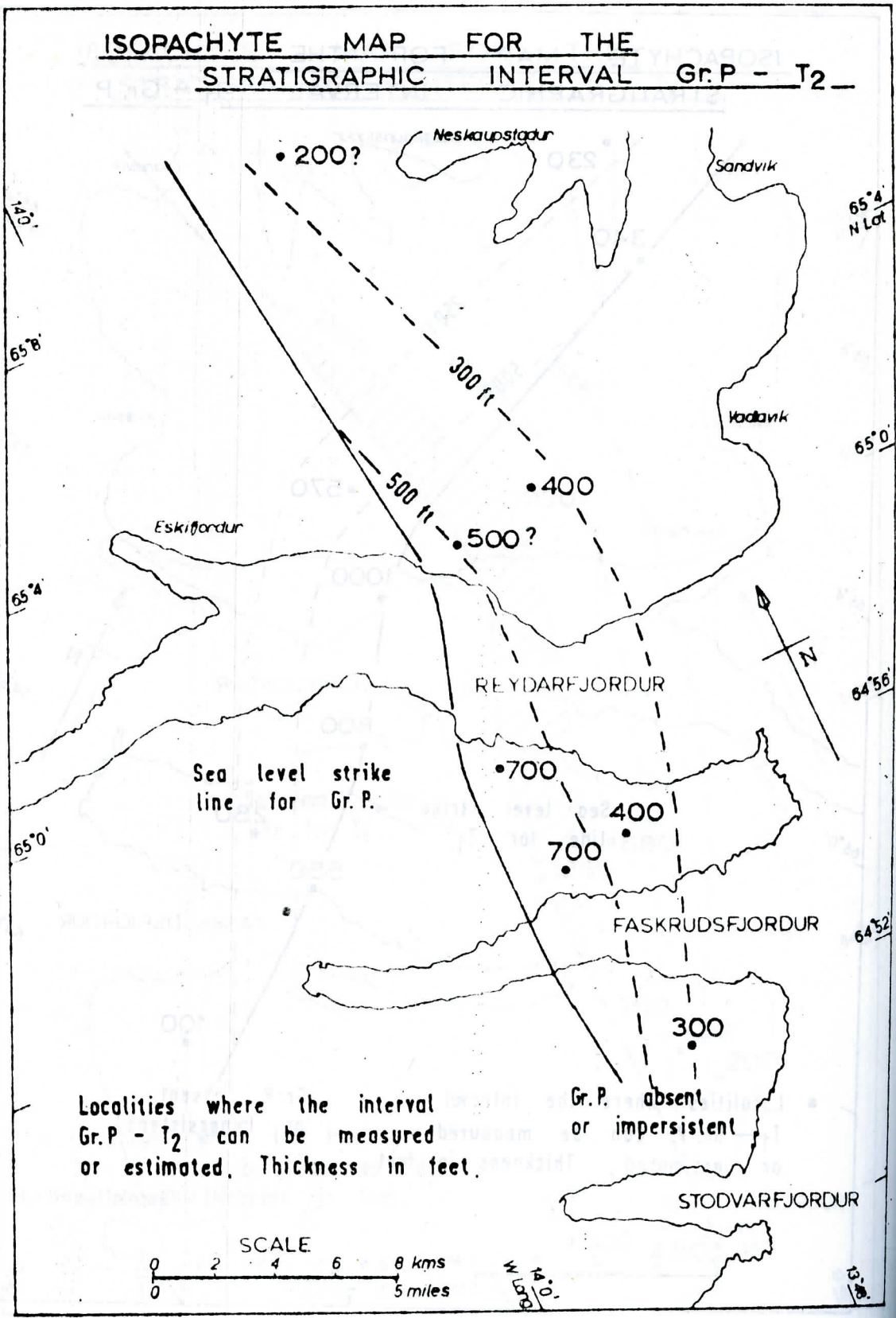

ISOPACHYTE MAP FOR THE STRATIGRAPHIC INTERVAL Gr. P - T2
Neskaupstadur
Sandvik
Vadlavik
Eskifjordur
REYDARFJORDUR
FASKRUDSFJORDUR
STODVARFJORDUR
200?
300 ft
400
500 ft
500?
700
400
700
300
N
Sea level strike line for Gr. P.
Localities where the interval Gr. P - T2 can be measured or estimated. Thickness in feet.
Gr. P. absent or impersistent
SCALE
0 2 4 6 8 kms
0 5 miles
65°4' N Lat
65°0'
64°56'
64°52'
14°0' W Long
13°58'

Fig. 17

In each case it can be shown that the succession between two "time bedding" planes formed an elongated lens of lavas, now tilted to the west by regional movements, which results in only the easterly half of the lens being exposed above sea level. At first it was thought that this distribution pattern might be produced by the thin lavas being "moulded" on to a pre-existing ridge of rhyolitic andesite lavas, these latter flows controlling the shape of the group as a whole. However, the stratigraphic unit T_1 - Grakollur porphyritic group (Gr.P.) shows the same distribution pattern and there are no rhyolitic andesite lavas within this part of the succession.

In order to produce an elongated lens of lavas it is necessary to postulate that more lavas were erupted from positions along or close to the north/south central axis than from localities away from the central line, i.e. it is inferred that there was "preferential deposition" along the axis of the lens.

Both the upper and lower surfaces of the lens are time/bedding horizons and were probably horizontal at the time of deposition. It ~~is~~ therefore follows that during the outpouring of the lavas that now form the lens there was a complimentary amount of subsidence. The subsidence was concentrated along the north/south depositional axis so that usually no ridge of lavas was produced along this line.

†††††††††