CHAPTER VIII

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Minor Intrusions, Faults and Secondary Mineralisation.

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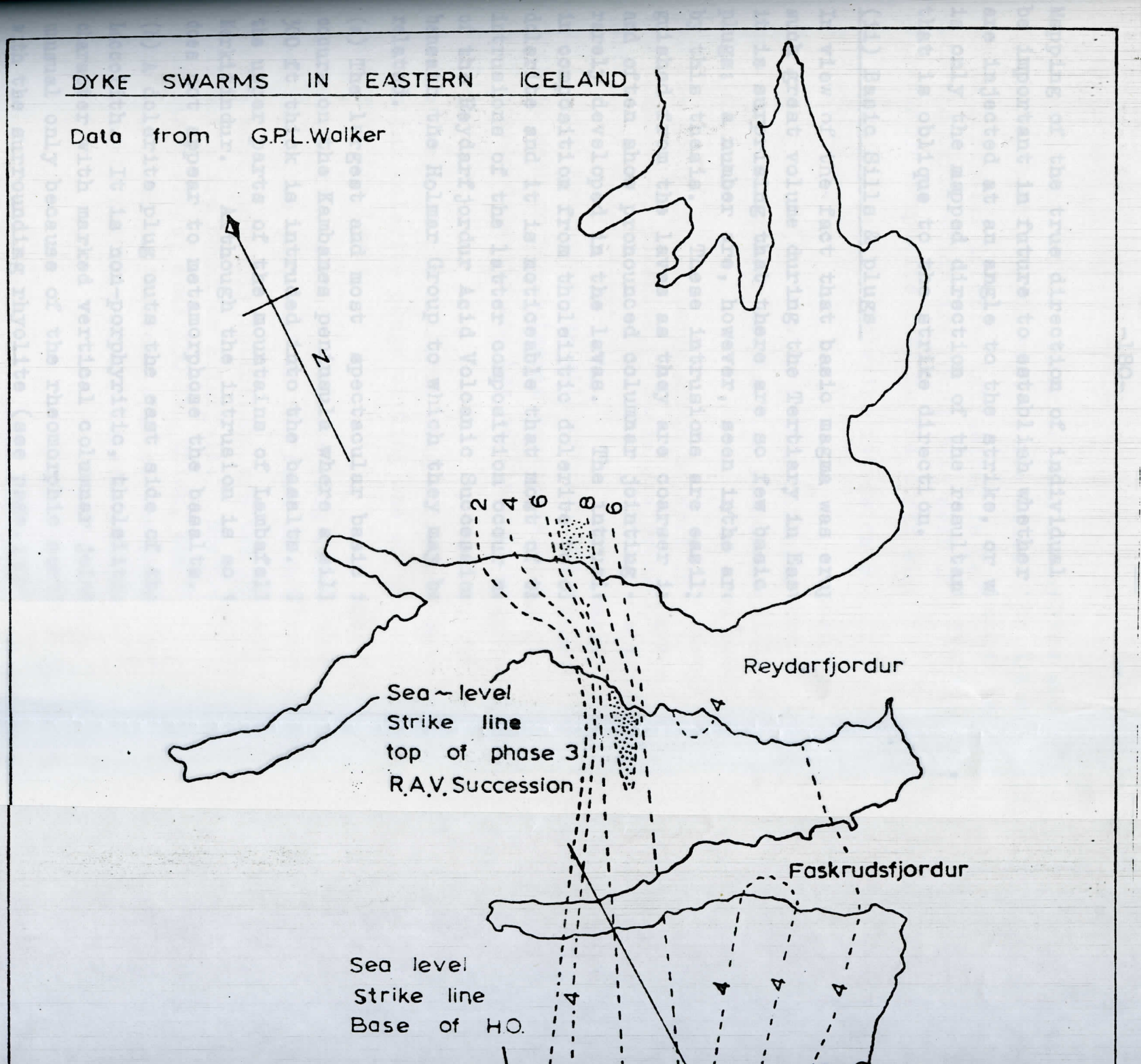
(i) The Reydarfjordur Dyke swarm.

The Reydarfjordur dyke swarm was first recorded and studied by Walker (1959. p.385. fig. 6) Since then the same author has mapped the dyke swarms present in much of Eastern Iceland, and the map of the Reydarfjordur and Berufjordur swarms (fig.38) is compiled from data given in Walker (1963) & Gibson, Kinsman and Walker (in press)

The swarm passing through Reydarfjordur and Faskrudsfjordur is well defined and reaches a density of over 8% near Thernunes and Sellatur. It everywhere decreases in intensity with increasing altitude and it is clear that in general the dykes are the feeders for the lavas. (Walker, 1960)

The swarm trends at about 20° and it is important to note that this is oblique to the strike. In particular south of Faskrudsfjordur the dyke swarm cuts across the sea-level strike line for the top of phase three of the Reydarfjordur Acid Succession. Phase four is very local and phases five and six are only well developed north of Reydarfjordur, which suggests that much of the dyke swarm south of Faskrudsfjordur is in fact unrelated to the Reydarfjordur centre.

This marked concentration of dykes south of Faskrudsfjordur may have fed the lavas of the Ornolsfjall and Kumlafell groups which reach a combined thickness of over 3,000 ft. in Stodvarfjordur. It is possible that there is a separate swarm of dykes related to these and, perhaps, some of the overlying groups of flood basalts, but that in the statistical treatment of the dykes this and the Reydarfjordur swarm have been mapped as a single unit.


DYKE SWARMS IN EASTERN ICELAND
Data from G.P.L.Walker
N
2
4
6
8
6
Reydarfjordur
Sea ~ level
Strike line
top of phase 3
R.A.V. Succession
4
Faskrudsfjordur
Sea level
Strike line
Base of H.O.
4
4
4
4

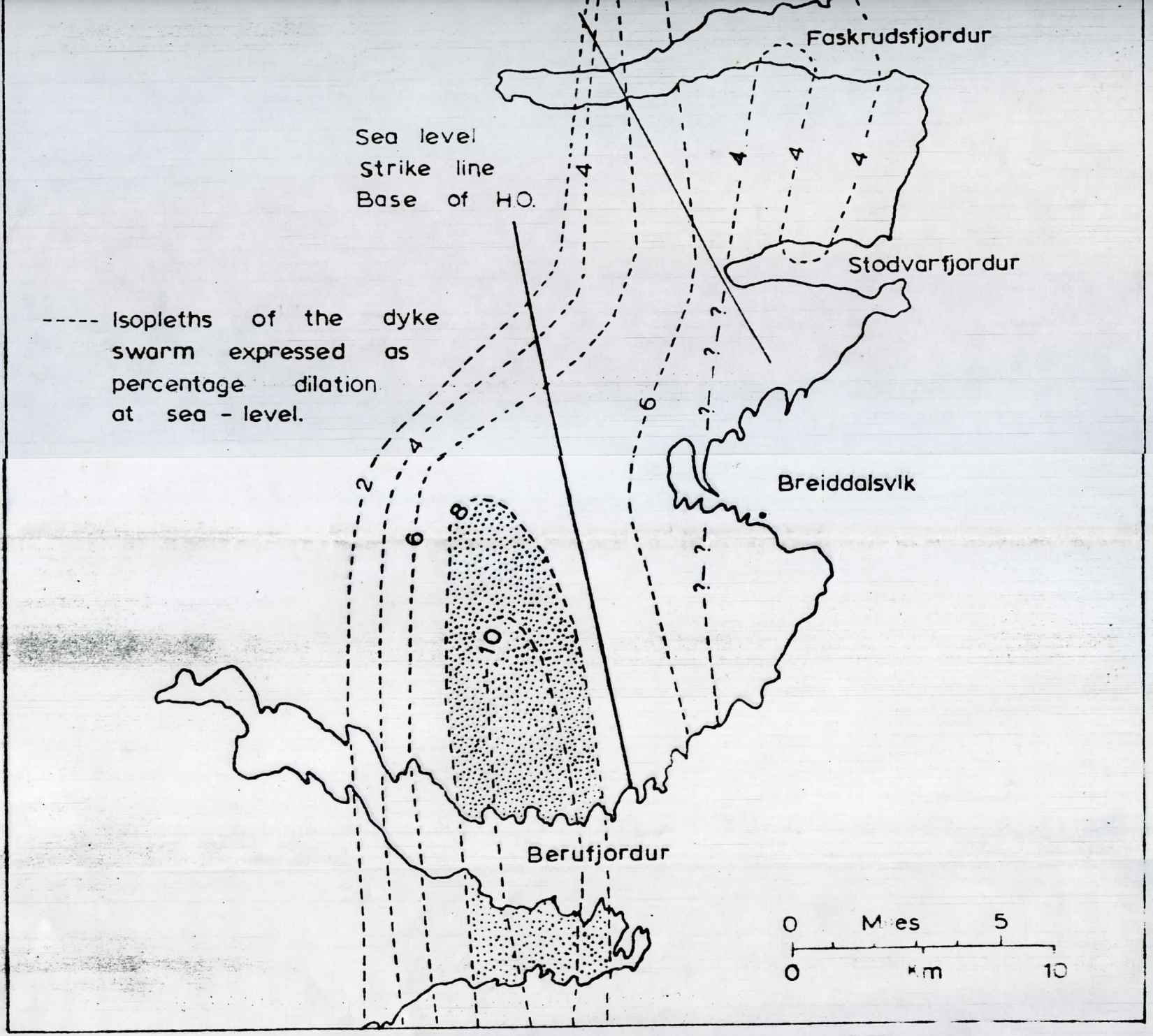

Faskrudsfjordur
Sea level
Strike line
Base of H.O.
Stodvarfjordur
----- Isopleths of the dyke swarm expressed as percentage dilation at sea - level.
Breiddalsvik
Berufjordur
0 Miles 5
0 Km 10

Fig. 38

Mapping of the true direction of individual dykes may be important in future to establish whether the dykes are injected at an angle to the strike, or whether it is only the mapped direction of the resultant swarms that is oblique to the strike direction.

(ii) Basic Sills & plugs

In view of the fact that basic magma was erupted in such great volume during the Tertiary in Eastern Iceland, it is surprising that there are so few basic sills and plugs; a number are, however, seen inthe area covered by this thesis. These intrusions are easily distinguished from the lavas as they are coarser in grain and often show pronounced columnar jointing - a feature rarely developed in the lavas. The intrusions range in composition from tholeiitic dolerite to olivine dolerite and it is noticeable that most of the intrusions of the latter composition occur near the top of the Reydarfjordur Acid Volcanic Succession, just beneath the Holmar Group to which they may be genetically related.

(a) The largest and most spectacular basic intrusion occurs on the Kambanes peninsula where a sill over 300 ft thick is intruded into the basalts. It now forms the upper parts of the mountains of Lambafell and Merkitindur. Although the intrusion is so thick it does not appear to metamorphose the basalts.

(b) A dolerite plug cuts the east side of the Sandfell Laccolith. It is non-porphyritic, tholeiitic in character with marked vertical columnar jointing. It is unusual only because of the rheomorphic contact relations with the surrounding rhyolite (see page.133)

(c) A small tholeiitic dolerite sill is exposed on the shore about 100 yds west of the Gilsa.

(d) An irregular dolerite intrusion, in part columnar, cuts the tuffs which are found just west of the Lower Gilsardalur composite lava on the north side of Gilsardalur.

(e) A large irregular dolerite intrusion occurs north west of Kerlingarfjall.

(f) A plug of dolerite with a near-circular cross-section forms the spectacular needle like prominence west of Soleyjartindur.

(g) The group of headlands north of Eyri in Reydarfjordur are composed of dolerite. These are probably separated parts of a single sill.

(h) A large transgressive sill between 100 and 200 ft. thick is seen on the Holmanes Peninsula. The intrusion is of course dolerite and has well marked columnar jointing.

(j) Just west of the Sellatur plug there are two cylindrical dolerite plugs cutting one of the fifth phase rhyolite lavas.

(k) A small fine-grained dolerite plug cuts the second phase rhyolites just east of the farm of Sellatur.

(l) The most northerly intrusions are two olivine dolerite sills which are found on Holafjall. North of the summit an inclined sheet, some 150 ft. thick, cuts the Seldalur tuffs, while on the eastern spur of the mountain/similar sill cuts the Sixth Phase rhyolites.

(iii) Acid and Composite Minor Intrusions

Several distinct sets of minor acid or composite intrusions are found associated with the Reydarfjordur Acid Volcanic Succession.

As already noted a swarm of inclined sheets cuts the basalt lavas in the area between Berunes and Thernunes and is also found on the north side of Reydarfjordur, near Helgustadir (Walker, 1959, p.379) These sheets may be offshoots from a larger acid intrusion underlying the fjord.

At a somewhat later date four composite dykes were injected, of which three at least reached the surface and gave rise to distinctive composite lavas. The following table summarizes their properties. The fourth dyke occurs on both shores of Reydarfjordur, being 45 ft. wide on the south side and occurring ½ mile west of Hafranes.

Data for exposures on the north shore of Faskrudsfjordur.	Dyke feeder for the Upper Gilsardalur Composite lava south-west of Kjappeyri.	Dyke feeder for the Lower Gilsardalur Composite lava below Kjappeyri	Dyke feeder for Kottur Composite Lava ¾ mile east of Kjappeyri
	S.shore	N.shore	N.shore
Height of outcrop below extrusive level.	1,800 ft.	1,000 ft.	1,750 ft.
Total thickness.	?	17 ft. approx.	88 ft. approx
W.basic margin	1 ft.	1 ft.	4 ft.
acid centre	?	15 ft.	80 ft.
E.basic margin	?	1 ft.	4 ft.
Trend of dyke	25°	due N.	30°
Outcrop length	3 miles	1¾ mile	3¼ miles
Phenocrysts in acid portion Xenocrysts in brackets.	none	quartz Sodic-plag. (Bytownite)	Anorthoclase (Bytownite)
Phenocrysts in basic portion Xenocrysts in brackets	none	(Quartz sodic-plag.) Bytownite	(Anorthoclase) rare Bytownite

A third group of acid minor intrusives consists of approximately six composite dykes which form a small swarm centred on the Sandfell laccolith (fig.39). The dykes have very characteristic phenocrysts; euhedral quartz and sanidine are both abundant in the acid portions of all the dykes, sometimes accompanied by sodic plagioclase and fragments of granophyric intergrowth of quartz and potash feldspar.

The dykes average 40 ft. thick and where they have been studied along the fjord shores they are composite, normally consisting of basic margins flanking a much thicker acid centre. However, when the same dykes are traced to the summits of the intervening ridges, a gain in altitude of some 2,000 to 2,500 ft., they are invariably thinner and normally lack basic margins.

The dyke near Brimnes, onthe north side of Reydarfjordur, is unusual in that it consists of five components arranged in the fashion B.A.B.A.B., i.e. the dyke has marginal basic, sub-marginal acid and central basic components. The dyke is poorly exposed inland, but what is almost certainly its continuation is found just below the summit of Kerlingarfjall where it is entirely acid with thin pitchstone margins. As the dyke is traced upwards it is found to be joined to a tabular rhyolite body, perhaps some 150 yds in diameter, which forms the summit of Kerlingarfjall. As this rhyolite shows columnar jointing and lacks platy flow structure, it is probably a sill rather than a lava.

Two basic dykes with quartz xenocrysts which cut the Kottur composite lava, are tentatively grouped with

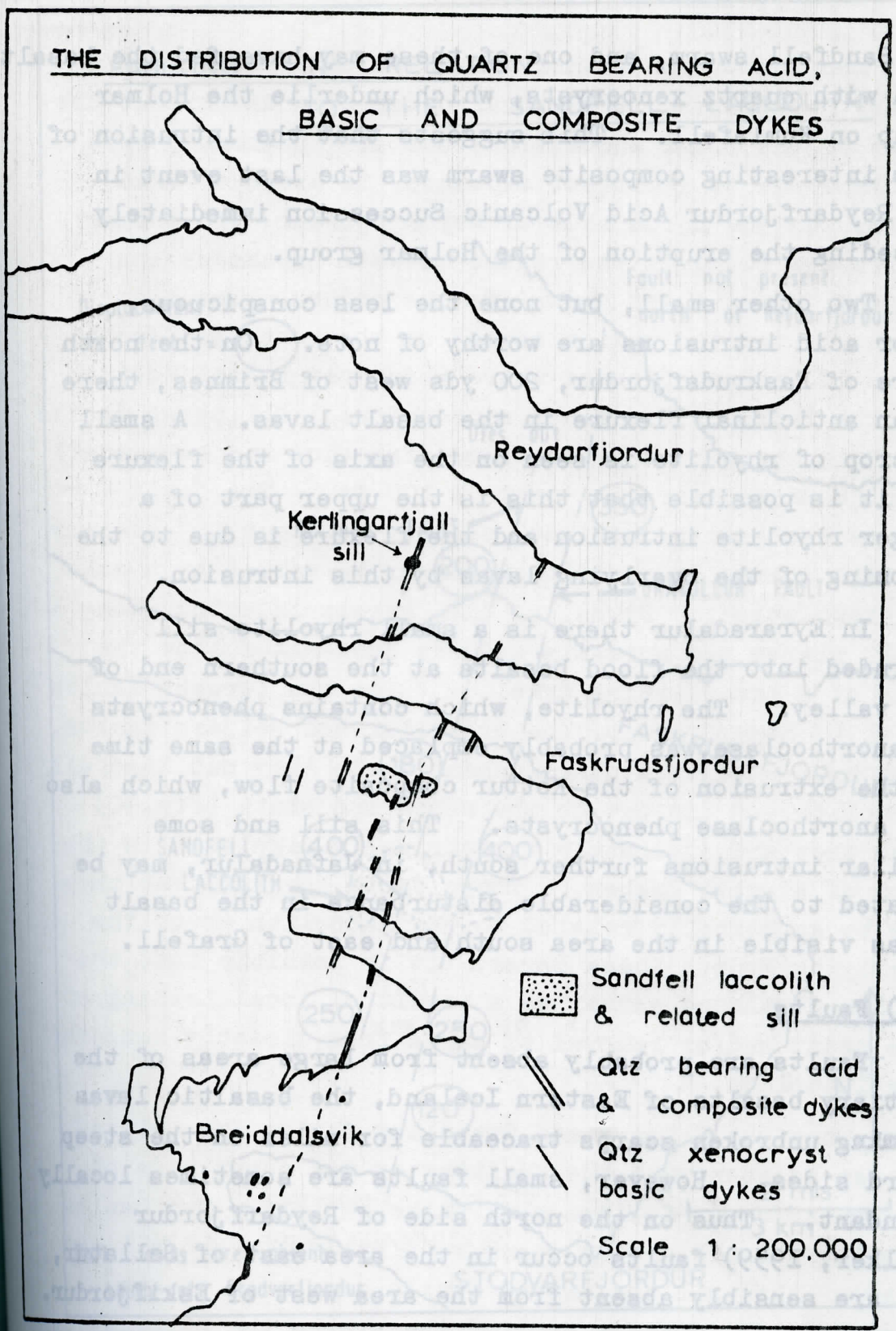

THE DISTRIBUTION OF QUARTZ BEARING ACID, BASIC AND COMPOSITE DYKES
Reydarfjordur
Kerlingarfjall sill
Faskrudsfjordur
Breiddalsvik
Sandfell laccolith & related sill
Qtz bearing acid & composite dykes
Qtz xenocryst basic dykes
Scale 1 : 200,000

Fig. 39

the Sandfell swarm, and one of these may have fed the basalt lava with quartz xenocrysts, which underlie the Holmar Group on Kumlafell. This suggests that the intrusion of this interesting composite swarm was the last event in the Reydarfjordur Acid Volcanic Succession immediately preceding the eruption of the Holmar group.

Two other small, but none the less conspicuous, minor acid intrusions are worthy of note. On the north shore of Faskrudsfjordur, 200 yds west of Brimnes, there is an anticlinal flexure in the basalt lavas. A small outcrop of rhyolite is seen on the axis of the flexure and it is possible that this is the upper part of a larger rhyolite intrusion and the flexure is due to the updoming of the overlying lavas by this intrusion.

In Eyraradalur there is a small rhyolite sill intruded into the flood basalts at the southern end of the valley. The rhyolite, which contains phenocrysts of anorthoclase, was probably emplaced at the same time as the extrusion of the Kottur composite flow, which also has anorthoclase phenocrysts. This sill and some similar intrusions further south, in Jafnadalur, may be related to the considerable disturbance in the basalt lavas visible in the area south and east of Grafell.

(iv) Faults

Faults are probably absent from large areas of the Tertiary basalts of Eastern Iceland, the basaltic lavas forming unbroken scarps traceable for miles on the steep fjord sides. However, small faults are sometimes locally abundant. Thus on the north side of Reydarfjordur (Walker, 1959) faults occur in the area east of Sellatur, but are sensibly absent from the area west of Eskifjordur.

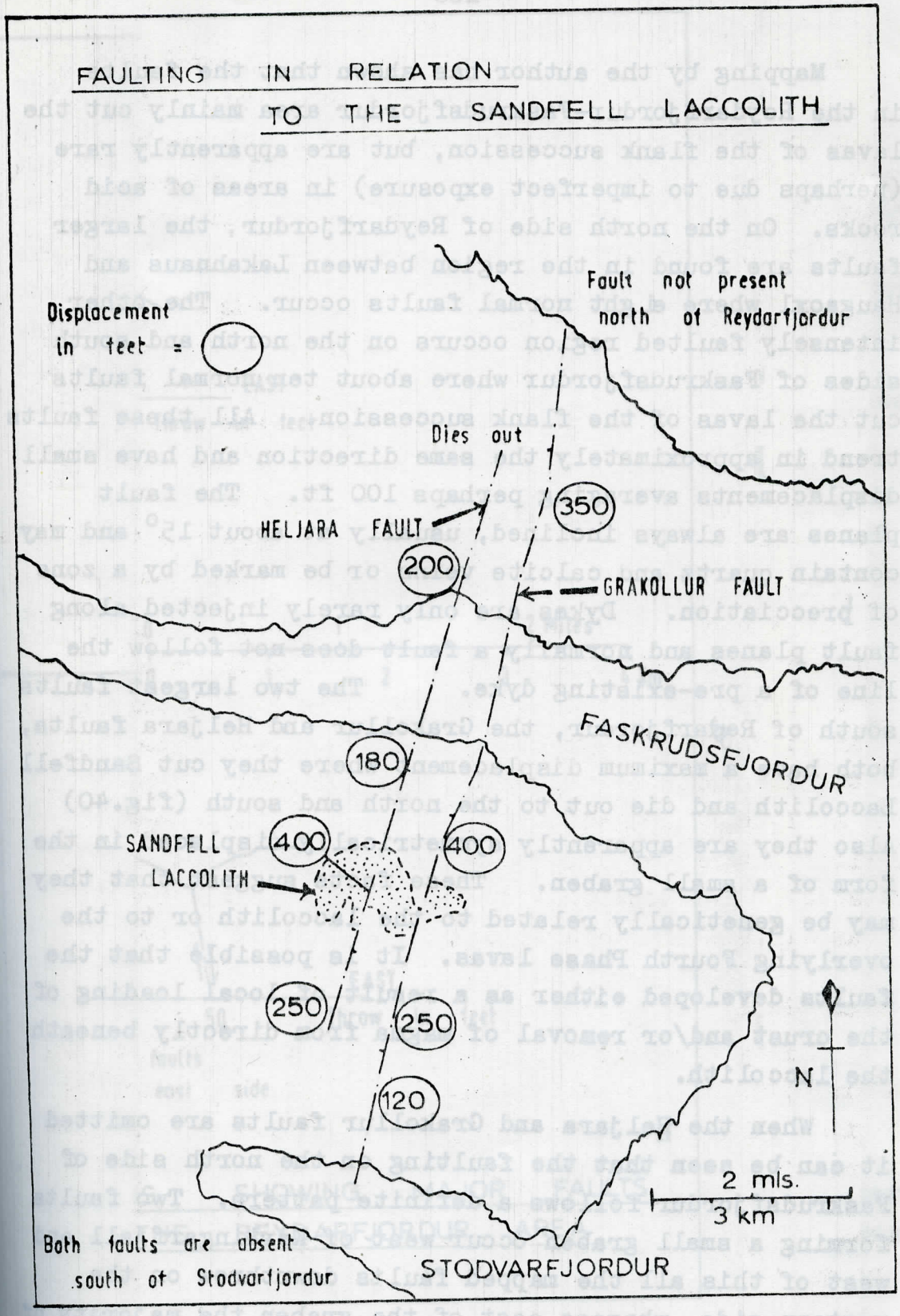
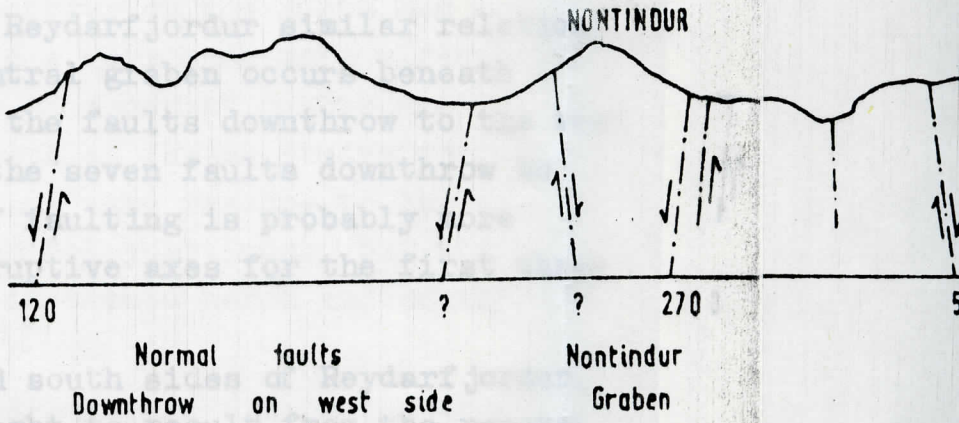

FAULTING IN RELATION
TO THE SANDFELL LACCOLITH
Displacement in feet =
Fault not present north of Reydarfjordur
Dies out
350
HELJARA FAULT
200
GRAKOLLUR FAULT
FASKRUDSFJORDUR
180
SANDFELL LACCOLITH
400
400
250
250
120
N
2 mls.
3 km
Both faults are absent south of Stodvarfjordur
STODVARFJORDUR

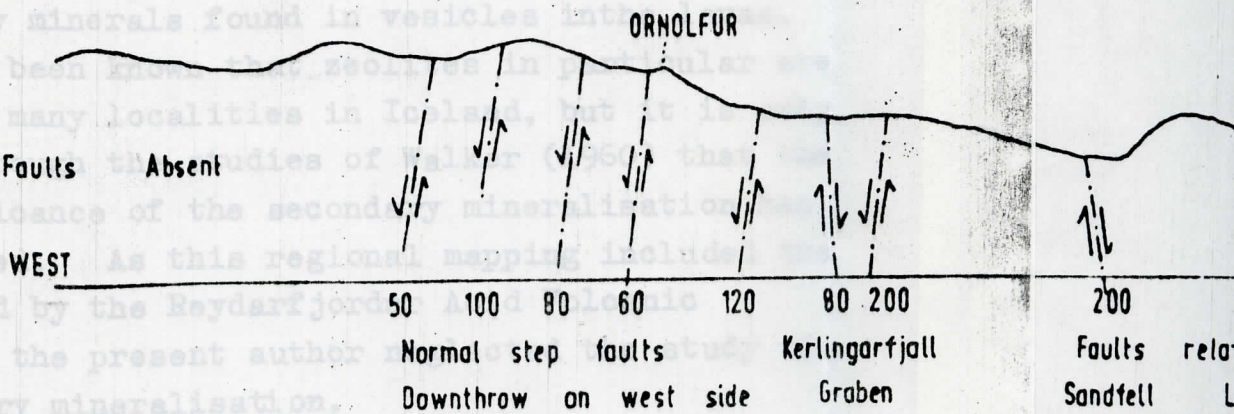
Fig. 40

Mapping by the author has shown that the faults in the Reydarfjordur-Faskrudsfjordur area mainly cut the lavas of the flank succession, but are apparently rare (perhaps due to imperfect exposure) in areas of acid rocks. On the north side of Reydarfjordur, the larger faults are found in the region between Lakahnaus and Haugaoxl where eight normal faults occur. The other intensely faulted region occurs on the north and south sides of Faskrudsfjordur where about ten normal faults cut the lavas of the flank succession. All these faults trend in approximately the same direction and have small displacements averaging perhaps 100 ft. The fault planes are always inclined, usually at about 15° and may contain quartz and calcite veins or be marked by a zone of brecciation. Dykes are only rarely injected along fault planes and normally a fault does not follow the line of a pre-existing dyke. The two largest faults south of Reydarfjordur, the Grakollur and Heljara faults, both have a maximum displacement where they cut Sandfell Laccolith and die out to the north and south (fig.40) Also they are apparently symmetrically displaced in the form of a small graben. These facts suggest that they may be genetically related to the laccolith or to the overlying Fourth Phase lavas. It is possible that the faults developed either as a result of local loading of the crust and/or removal of magma from directly beneath the laccolith.

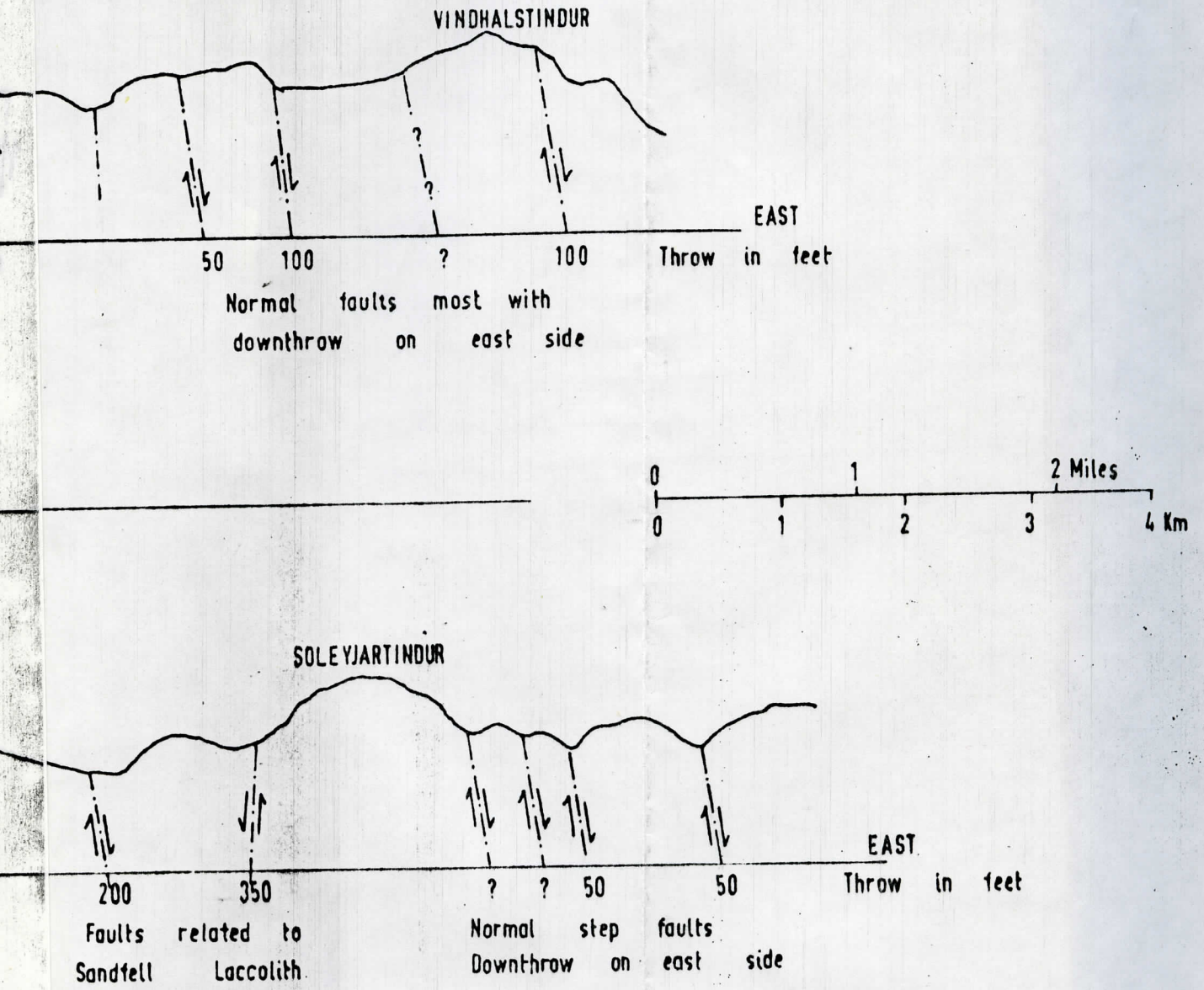
When the Heljara and Grakollur faults are omitted it can be seen that the faulting on the north side of Faskrudsfjordur follows a definite pattern. Two faults forming a small graben occur west of Kerlingarfjall and west of this all the mapped faults downthrow on the western side, whereas east of the graben the majority of



NORTH SIDE OF REYDARFJORDUR



VATTARNES PENINSULA [Some data from D.D.J. Kinsman]



SECTIONS SHOWING MAJOR FAULTS IN THE REYDARFJORDUR AREA

D.D.J. Kinsman]

Fig. 41

the faults downthrow on the opposite side. The small graben approximately coincides with the eruptive axes for the first three flank successions.

On the north side of Reydarfjordur similar relations are found. The small central graben occurs beneath Nontindur; west of it all the faults downthrow to the west while east of it five of the seven faults downthrow to the east. The pattern of faulting is probably more complicated here as the eruptive axes for the first three phases do not coincide.

On both the north and south sides of Reydarfjordur, the central graben is thought to result from the removal of magma or loading of the crust, but the step faulting on the flanks of the graben is un-explained.

(v) Secondary Mineralisation

One of the most interesting and revealing features of the flood basalts of Eastern Iceland is the suite of secondary minerals found in vesicles inthe lavas. It has long been known that zeolites in particular are abundant at many localities in Iceland, but it is only recently through the studies of Walker (1960) that the true significance of the secondary mineralisation has been realised. As this regional mapping included the area covered by the Reydarfjordur Acid Volcanic Succession, the present author neglected the study of the secondary mineralisation.

It is convenient to distinguish two types of secondary mineralisation in the Tertiary lavas of Eastern Iceland - local hydrothermal aureoles related to the cores of acid centres (Walker, 1963, fig.7) and a regional zeolitisation.

As stated earlier it is thought that the hydrothermal alteration or propylitisation in the Reydarfjordur area is produced by an underlying and unexposed intrusion. The more intensely altered rocks occur on the north and south sides of Reydarfjordur, while a very much more widespread, elongate, cupola shaped zone of abundant quartz and calcite extends north and south as far as Stodvarfjordur. On the Vattarnes peninsula this zone reaches to the top of the mountains of Mulli and Soleyjartindur, but its height falls steadily as it is traced north and south from here.

Outside the areas of hydrothermal alteration and the related quartz-calcite zones the lavas are affected by the regional mineralisation which has produced easily mapped, flat-lying mineral zones which cut across the basalt stratigraphy. Different suites of secondary minerals are developed in the tholeiites to those in the olivine basalts (Walker 1960)

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