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UNIVERSITY OF ICELAND

THE PETROLOGY OF ICELAND

SOME GENERAL REMARKS

by

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Introduction

This chapter summarizes some of the general petrological features of the volcanic zones of Iceland. The different rock suites and magma evolution can be correlated to the rift features as briefly discussed.

Jakobsson (1972) demonstrated a correlation between the chemical composition of the Recent basaltic rocks in Iceland and their location within the volcanic zones. The main purposes of the present study are:

1) To see if the correlation observed by Jakobsson (op.cit.) still holds, when the number of available chemical analyses of rocks from within the volcanic zones increases from the 56 originally observed to about 1000. The additional data are mostly published (e.g. Sigvaldason, 1974a & b), and unpublished analyses made in the laboratory of the Nordic Volcanological Institute and the Science Institute of the University of Iceland during the past years (and other available analyses referred to).

2) To incorporate into the systematics intermediate and acid rocks in addition to the basalts only, used by Jakobsson (op.cit.) and thus consider the entire spectrum of young Icelandic volcanic rocks. In most cases these are continuous rock suites ranging from basalts to highly silicic rocks.

3) To extend the time scale from Recent (ca. 10.000 years) to about 0.7 m.y. including interglacial and subglacial rocks. The possibility that the correlation extended this far was suggested by Jakobsson (op.cit.).

4) To classify the rock suites. No described classification scheme fits this purpose in all respects, mostly because some of the rock suites fall close to boundary lines or are characterized by chemical features not taken into consideration in the classification scheme. The relatively simple classification procedure of

Irvine & Baragar (1971) has been chosen for this purpose. Instead of the iron-titanium relation proposed by Irvine & Barager (op.cit.) to "correct" the iron-ratio of analyses, the popular but arbitrarily fixed Fe_2O_3:FeO ratio of 0.15 recommended by Brooks (1976) has been used in the norm calculations; even though the validity of its use may be questioned (especially in the case of alkaline rocks). Boundary cases have not been forced into either side categories. Basaltic tristanite is used where Irvine & Baragar (op.cit.) use trachybasalts for the low-silica intermediate rocks of the potassic alkaline rock suites and likewise tholeiitic icelandite and tholeiitic andesite are used for the low-silica intermediate rocks of the subalkaline suites.

Jakobsson´s (op.cit.) systematic division of the basalts is fourfold: Alkali olivine basalts occur in the Snæfellsnes volcanic zone (Western Zone of Jakobsson) and in Vestmannaeyjar, transitional alkali basalts in the southern part of the Sudurland volcanic zone (Eastern Zone), olivine tholeiites in the Reykjanes volcanic zone (Middle Zone) and tholeiites in the northern part of the Sudurland volcanic zone and the Nordurland volcanic zone (Northern Zone).

In short it may be said that the nearly 1000 analyses available show that the regional distribution observed by Jakobsson (op.cit.) holds for the basalts, but when the more evolved rocks are taken into account the classification needs modification in some cases. Lavas of all the main rock types discussed here have been erupted in Iceland in historic time, i.e. the last 1100 years.

Classification and distribution of rock types

The first attempt of the classification is to divide the rock suites into the subalkaline and alkaline categories. The alkali-silica diagram (Fig. 1) shows that most of the rock suites are subalkaline. Only two suites may be regarded as mildly alkaline, i.e. the Snæfellsnes and the Vestmannaeyjar rocks. These are Jakobsson´s (op.cit.) zones of alkali olivine basalts. The basic rocks of Hekla, Katla, Eldgjá (has produced basic rocks only) and Eyjafjallajökull and the low-silica intermediate rocks of the Torfajökull area (location on maps), i.e. the southernmost volcanoes of the Sudurland volcanic zone (north of the mildly alkaline Vestmanna-eyjar), fall close to the division line between subalkaline and alkaline rocks. These are termed transitional alkali basalts by Jakobsson (op.cit.). The more silicic rocks of these volcanoes all plot within the subalkaline filed. The rock suites of the whole area are thus probably best classified as subalkaline. Two of these rock suites, though, the Eyjafjallajökull and the Torfajökull area have silicic rocks that fall rather close to the division line. These may be termed transitional, while the rock suites of Katla and Hekla fall clearly among typical subalkaline rock suites. The silicic rocks of Hekla f.i. are lower in total alkalies than those of the typical tholeiitic rock suites of the Tertiary volcano, Thingmúli, in Eastern Iceland (Carmichael, 1964) and Kerlingarfjöll, a Pleistocene silicic center in Central Iceland (Grönvold, 1972). These two rock suites, Hekla and Katla, are therefore classified as subalkaline even though the basic rocks show alkaline affinities.

The rock suites of all the volcanoc zones of Iceland except the Snæfellsnes volcanic zone and the southernmost part of the Sudurland volcanic zone are thus typical subalkaline. The isolated volcano Öræfajökull is subalkaline as well.

Both the alkaline and the subalkaline rocks reveal significant compositional differences, which put these rocks into different categories when classified further. The alkaline rocks occur in two different areas, Snæfellsnes and Vestmannaeyjar. The ratio between Na_2O and K_2O of these two rock suites differs such, that they classify as potassic and sodic respectively (Fig. 2). The most silicic rocks of the Snæfellsnes volcanic zone have $Na_2O:K_2O$ ratios around 1 and the ratio slowly increases with decreasing SiO_2. A few of the basic rocks have $Na_2O:K_2O$ ratios similar to sodic rocks. Thus the rocks of the Snæfellsnes volcanic zone belong to the potassic alkaline rock series, but they are mildly potassic. The Vestmannaeyjar rocks have much higher $Na_2O:K_2O$ ratios and belong to the sodic alkaline rock series. The Snæfellsnes rocks range from picrite-basalt/ankaramite through alkali basalts, basaltic tristanites and tristanites to trachytes and the Vestmannaeyjar rocks range from picrite-basalts through alkali basalts to hawaiites. The rocks of Surtsey are lower in total alkalies than the rocks of Heimaey and closely approach tholeiitic compositions

The transitional rocks are boundary cases between subalkaline and alkaline. Two volcanic complexes fall in this category, Eyjafjallajökull and the Torfajökull area, and in both cases the rocks suites show a closer tendency towards subalkaline character than alkaline on the alkali-silica diagram (Fig. 1). If further classified as subalkaline they belong to the tholeiitic subgroup as seen on Fig. 3. If on the other hand these rock suites are looked upon as mildly alkaline and the classification carried on the two volcanic complexes differ in $Na_2O:K_2O$ ratios such that Eyjafjallajökull classifies among typical sodic rocks while Torfajökull area rocks are intermediate between sodic and potassic on the Ab-An-Or diagram (Irvine & Baragar, op.cit.) and the $Na_2O:K_2O$ ratio/silica-diagram. The difference between the sodic mildly alkaline rocks of

Vestmannaeyjar and the transitional rocks of Eyjafjallajökull is thus very small. The rock types of these two volcanoes, Torfajökull and Eyjafjallajökull are probably best termed tholeiites, tholeiitic icelandites, icelandites, dacites and rhyolites. Some of the Torfajökull rhyolites contain acmite ($<$ 2 per cent) and others contain corundum ($<$ 3.3 per cent) in the norm, while most of them contain neither of these.

In the area between Torfajökull and Eyjafjallajökull is one major volcano, Tindfjallajökull and a lava field of Pleistocene basaltic rocks erupted through short fissures. As the composition of these is unknown at present it is possible that calling the whole area transitional is incorrect. The scattered basalt analyses around Hekla, in the northern edges of the Torfajökull area and around Eyjafjallajökull all show high titanium (between 3.3 and 4.4 wt. per cent TiO_2). Even some of the Heimaey rocks contain over 3 wt. per cent TiO_2. These therefore closely approach the high-titanium tholeiites of Katla-Eldgjá and the whole eastern flank of the volcanic zone. This indicates that the whole basalt volcanism in the southern part of the Sudurland volcanic zone is of the high-titanium tholeiitic character and only the Torfajökull complex itself, which has produced almost entirely intermediate and acid rocks, is transitional.

The subalkaline rocks are all tholeiitic except the rocks of Hekla, which on the diagram of normative plagioclase composition against normative colour index plot among typical calc-alkaline rocks (Fig. 3). On the AFM-diagram on the other hand they fall among the iron-richest calc-alkaline rocks and the more iron-poor tholeiitic rocks. The bulk of the Hekla production is low-silica intermediate rocks and the eruptions are characterized by explosive activity and tephra production far more than any other volcano in Iceland not covered by ice. This reminds strongly of the typical calc-alkaline volcanoes of the world. The Hekla rocks are thus properly classified as calc-alkaline with tholeiitic affinities or as iron-rich calc-alkaline rocks. They range from (titan-enriched) tholeiites through tholeiitic andesites, andesites and dacites to rhyolites. The tholeiites of the southern part of the Sudurland volcanic zone differ from the tholeiites of the rest of the volcanic zones, which may be regarded as "normal" tholeiites, in the high Ti-content. TiO_2 mostly ranges from 3.5 to over 5 wt. per cent in these basalts compared to 1 to 2.5 wt. per cent TiO_2 as the most usual range in the tholeiites of the other volcanic zones. The tholeiites of the Katla-Eldgjá area (i.e. the eastern flank of the zone) are especially high in TiO_2 ($>$ 4.2 wt. per cent). These high-titanium area rocks range from high-titanium tholeiites through tholeiitic icelandites, icelandites and dacites to rhyolites. Thus the subalkaline rocks belong to "normal" tholeiitic rock series except the high-titanium tholeiitic rocks of the southern part of the Sudurland volcanic zone and the calc-alkaline rock suite of Hekla. The rock types of the "normal" tholeiitic series are tholeiites, tholeiitic icelandites, icelandites, dacites and rhyolites. The suites from Kerlingarfjöll and Námafjall-Krafla (Grönvold, 1972) may be taken as typical examples. Öræfajökull volcano has produced some low-iron intermediate rocks showing calc-alkaline affinities on the AFM-diagram and plotting as icelandites and dacites on the diagram of normative plagioclase composition against normative colour index, while other intermediate rocks of the volcano are typical icelandites. This calc-alkaline affinity has been shown to be the result of a mixing of the typical basic and acid tholeiitic magmas of the volcano (Prestvik, in prep.). A peralkaline rock has been found in Öræfajökull (Carmichael, 1967b).

On the maps (Figs. 4 & 5) is shown the systematic distribution of the rock series in the volcanic zones of Iceland. In summary it may be said that the distribution pattern is simple; all the volcanic zones produce relatively distinct rock types except the southern part of the Sudurland volcanic zone. This particular zone is rather complex and may be said to be characterized by mildly alkaline sodic rocks in its southernmost area (the Vestmannaeyjar group of islands ± Eyjafjallajökull volcano). Otherwise the basic rocks of the area seem to be high-titanium basalts (with mild alkaline affinities), while the more evolved rocks differ from one central volcano to another. The silicic rocks of Hekla are calc-alkaline. The Torfajökull area silicic rocks are transitional (with some occurrences of both slightly peralkaline and peraluminous rocks). The silicic rocks of Katla are of typical tholeiitic character (icelandites - rhyolites) and the Eyjafjallajökull silicic rocks are best classified as transitional or as tholeiitic with sodic mild alkaline affinities. The evolved rocks of the Tindfjallajökull volcano are of unknown composition. As said above the southernmost of the Vestmannaeyjar rocks, these of Surtsey, are fairly close to tholeiites in composition. There seems to be a continuous increase in K_2O relative to Na_2O (at similar SiO_2 content) from Surtsey across Heimaey and Eyjafjallajökull to the Torfajökull area, which has the highest $Na_2O:K_2O$ ratio of these rocks, that have been erupted along the NE-SW "median belt" of this volcanic zone.

Rifting in relation to rock types

The Nordurland volcanic zone, the Sudurland volcanic zone and the Reykjanes volcanic zone south of Thingvellir are characterized by swarms of faults, open fissures and eruptive fissures up to tens of km in length (Kjartansson, 1960, 1962, 1965 & 1968; Sæmundsson, 1977). This tectonic feature, together with the fact that these zones produce rocks of the typical tholeiitic rock series only, has led to the identification of these as the spreading axis of the Icelandic rift system. Tholeiitic rocks are produced in the Reykjanes volcanic zone north of Thingvellir as well, but no major rifting seems to be taking place there at present; at least the rift features are much less prominent than south of Thingvellir. The Eldgjá-Katla area on the eastern flank of the Sudurland volcanic zone produces high-titanium tholeiites and is characterized by a major fissure swarm. The calc-alkaline Hekla is likewise characterized by a major fissure swarm. The fissure swarm characteristics in the "median belt" in the Sudurland volcanic zone and in the Snæfellsnes volcanic zone are not as prominent and these areas do not produce typical tholeiitic rocks. The open fissures are f.i. not found in these areas and the eruptive fissures are always very short compared to the tholeiitic areas (Kjartansson, 1962 & 1968). The role of these areas in relation to the ocean floor spreading is less clearly understood and will not be discussed here. The Sudurland fracture zone which is mainly recognized by earthquakes (Björnsson & Einarsson, 1974) offsets the spreading from the Reykjanes volcanic zone to the Sudurland volcanic zone. This fracture zone meets the Reykjanes volcanic zone south of Thingvellir and the Sudurland volcanic zone at Hekla according to earthquake distribution (Björnsson, 1976). Outside the axial rift zones tholeiitic rocks and rocks with tholeiitic affinities are thus produced in three volcanic areas. Two of these, the southern end of the Sudurland volcanic zone and the northern end of the Reykjanes volcanic zone are a direct continuation of the axial rift zones beyond their joint with the offsetting fracture zone. The volcanism of these areas is most probably the result of fading out high geothermal gradient of the rift zones extending below these areas. The third tholeiitic area outside the axial rift is the isolated central volcano, Öræfajökull. The Snæfellsnes volcanic zone is thus the only volcanic area in Iceland not producing tholeiitic rocks or rocks with tholeiitic affinities. Compared on the basis of equal area and time it seems to be much less productive than the other volcanic zones (Jakobsson, op.cit.). Its relation to the spreading or rifting process is uncertain even though the craters tend to form NNW-ESE linear trends (Kjartansson, 1968). The Snæfellsnes volcanic zone has in the literature frequently been interpreted as a fracture zone extending across middle Iceland (f.i. Sigurdsson, 1970; Ward, 1971; Jakobsson, op.cit.). This seems doubtful for at least three reasons: 1) It is not very active seismically (Björnsson & Einarsson, op.cit.). 2) The alkaline volcanism all occurs outside the supposed offsetting segment of the zone. 3) Two closely spaced fracture zones (the Snæfellsnes fracture zone and the Sudurland fracture zone) would then be operating in Iceland to offset the Reykjanes Ridge spreading towards the spreading in the eastern part of Iceland. Between these two fracture zones are then situated two parallel spreading ridge segments, the northern halves of the Reykjanes volcanic zone and the Sudurland volcanic zone. The most intense rift swarms of these volcanic zones fit much better to a fracture zone offsetting in Sudurland than in the continuation of the Snæfellsnes volcanic zone. A much more complex picture of the spreading in Iceland has been put forward by Walker (1975), according to which spreading takes place on six different spreading zones.

The rock chemistry and evolution within the rift zone

The tholeiitic rift zones are characterized by parallel or en echelon arranged rift swarms. The rift of each swarm is expressed by three features: faults, open fissures and eruptive fissures. The faults most often form a graben structure. The eruptive fissures are characteristically recognized by crater rows or subglacial hyaloclastite ridges, but they may be pure negative topographic features as f.i. Eldgjá. The length of both individual fissures and rift swarms varies greatly. Their age is most probably varyable as well; which means that they are in different stages of evolution. The main rift swarms of the present rift zones are shown schematically in Fig. 6.

It was shown by Jakobsson (op.cit.) that the volcanic production (on equal time and area basis) increases inland along the rift zones. Similarly Sigvaldason et al. (1974 & 1976) have shown that chemical variation of the tholeiites occur systematically within the volcanic zones as well as within each rift swarm and thus correlates with the amount of the production. The chemical variations of the tholeiites are to be seen in numerous elements, but they are most pronounced in the LIL-elements. K_2O, TiO_2 and P_2O_5 f.i. have the same variation pattern and show these variations quite clearly. K_2O will be used here to demonstrate this variation. Low potassium tholeiites (abyssal type tholeiites) occur all over the rifting zones together with potassium-enriched tholeiites. The degree of the potassium enrichment on the other hand increases inland along the rift zones towards a maximum in the Kverkfjöll area in central Iceland (Fig. 7). Within each rift swarm the potassium enrichment increases in the same way towards the center of the rift swarm. As the rift swarms approach Kverkfjöll they are characterized by increasing potassium enrichment. Other components vary sympathetically. The MgO variation pattern is in keeping with Jakobsson´s (op.cit.) observation that olivine tholeiites are more abundant in the Reykjanes volcanic zone than in the northern half of the Sudurland volcanic zone. The increased number of analyses has revealed the existence of numerous quartz-normative tholeiites on the Reykjanes volcanic zone (Olivine-tholeiite Zone of Jakobsson (op.cit.)). The tholeiites of the Reykjanes volcanic zone are, however, generally higher in MgO than the tholeiites of the rest of the zones, as is to be expected according to this pattern of rock evolution.

Expressed in other words; evolved tholeiites increase in amount and the amount of their evolution increases towards the centre of both the rift zones and the individual rift swarms. This evolution goes even further towards intermediate and acid rocks. A successful rift swarm may thus evolve into a central volcano (Sigvaldason et al., 1976) and most of the present rift swarms in fact have, as shown on Fig. 6. These central volcanoes are in different stages of evolution. A central volcano of this type has not been defined, but their main features are a rift swarm, a diversity of rock types ranging from basalts to highly silicic rocks, an associated high temperature thermal activity and a caldera collapse (in cases at least). A typical example of an active central volcano of this type, comprising all these features, is Námafjall-Krafla, where a major rifting episode is going on at present (Björnsson et al., 1977). A Tertiary central volcano of this type, the Breiddalur central volcano, eastern Iceland, has been excellently described by Walker (1963) and the petrology of another Tertiary central volcano, the Thingmúli central volcano, eastern Iceland, has been described by Carmichael (1964 & 1967). The time needed for a rift swarm to evolve into a central volcano is probably different as the rift swarms differ regarding activity, which may in fact stop at any stage. No natural boundaries exist between the central volcano stage and the pre-central volcano stage of a rift swarm. The first appearance of the high temperature thermal activity or the first appearance of silicic rocks or even qz-normative rocks might be used to indicate the initiation of a central volcano stage. The caldera collapse stage usually appears later than these features if the volcano collapses at all. Rift swarms of intense high temperature thermal activity but no highly evolved silicic rocks (qz-normative rocks are even scarce) or calderas are found on the Reykjanes peninsula (see Fig. 6). Whether these are to be called central volcanoes or not is a matter of opinion. In the case of the early Quaternary central volcano, Húsafell, western

Iceland, the life span of the central volcano from the first appearance of silicic rocks to its extinction was found to be 0.5 m. years (Sæmundsson & Noll, 1974). As an order of magnitude 1 m. years is thus probably not an overestimated figure for the life span of a rift swarm from its early stages to extinction and probably in good keeping with the speed of oceanic rifting.

This picture given here of the evolution of central volcanoes refers to the subalkaline ones only. Whether the evolution of the alkaline silicic complexes in the Snæfellsnes volcanic zone is in any way comparable to these is unknown and the same holds for the transitional silicic complexes in the "median belt" of the Sudurland volcanic zone. It is obvious though, that the Torfajökull complex is unique among the present Icelandic central volcanoes not least in being much more productive regarding silicic rocks than all the others. It is almost entirely built up of silicic rocks while Kerlingarfjöll, the second most productive regarding silicic rocks, has only about 25 per cent silicic rocks (Grönvold, 1972).

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Figure Captions

Fig. 1. Alkali-silica diagram showing the trends of some Icelandic rock suites discussed in the text. dl = division line of Irvine & Baragar (1971), V = Vestmannaeyjar (data from Steinthorsson, 1966; Jakobsson, 1968; Jakobsson et al., 1973; Thorarinsson et al., 1973 and Nord. Volc. Inst. & Sci. Inst. unpubl.), S = Snæfellsnes volcanic zone (data from Sigurdsson, 1970 and Steinthorsson, Sci. Inst. unpubl.), E = Eyjafjallajökull (data from Sigurdsson, 1970a and Nord. Volc. Inst. & Sci. Inst. unpubl.), T = Torfajökull area (data from Sigurdsson, 1970a; Grönvold, 1972 and Nord. Volc. Inst. & Sci. Inst. unpubl.), O = Öræfajökull (data from Prestvik, Nord. Volc. Inst. unpubl. ; Thorarinsson, 1958; Carmichael, 1967 and Nord. Volc. Inst. & Sci. Inst. unpubl.), K = Katla-Eldgjá (data from Sigurdsson, 1970a; Thorarinsson, 1958; Robson, 1956; Nord. Volc. Inst. & Sci. Inst. unpubl.), Ke = Kerlingarfjöll (data from Grönvold, 1972), H = Hekla (data from Tryggvason, 1965; Einarsson, 1950; Thorarinsson, 1954 & 1967; Sigvaldason, 1969 & 1974; Sigurdsson, 1970a; Baldridge et al., 1973; Nord. Volc. Inst. & Sci. Inst. unpubl.), N = Námafjall-Krafla (data from Grönvold, 1972 and Nord. Volc. Inst. unpubl.), Th = Thingmúli, Tertiary central volcano, Eastern Iceland (Carmichael, 1964).

Fig. 2. Na_2O:K_2O ratio versus SiO_2 of the rock suites from Snæfellsnes volcanic zone and southern end of Sudurland volcanic zone showing their potassic and sodic nature respectively (data as in Fig.1).

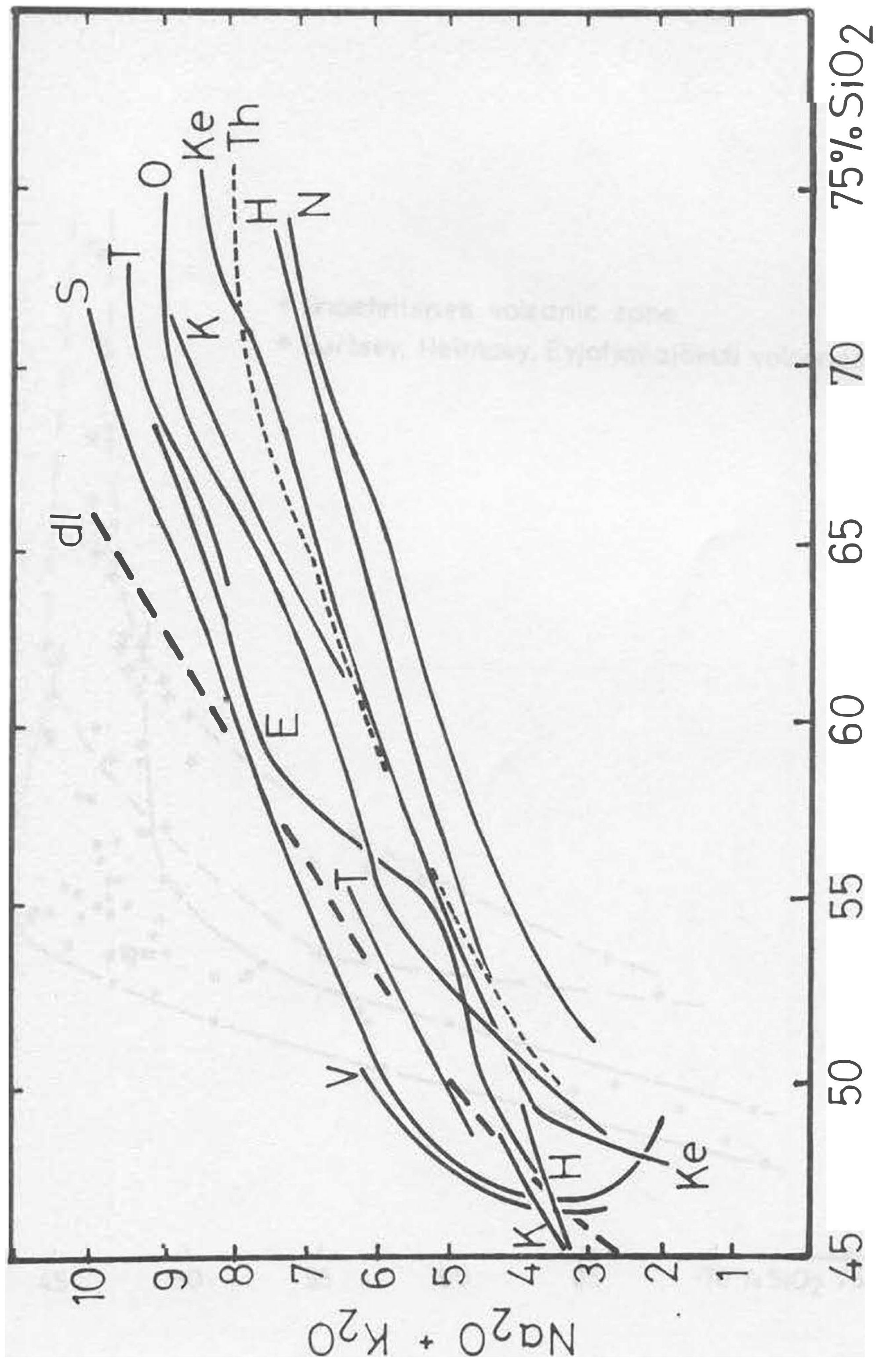
Fig. 3. A plot of normative plagioclase composition versus normative colour index showing the calc-alkaline character of Hekla in A compared to the tholeiitic character of the Öræfajökull rocks (x) and the transitional rocks of the Torfajökull area (o) and Eyjafjallajökull (o) in B (data as in Fig. 1).

Fig. 4. The volcanic zones of Iceland and the systematic distribution of rock types. N = Námafjall-Krafla volcano, Ke = Kerlingarfjöll volcano, Th = the Tertiary volcano Thingmúli, Tv = Thingvellir.

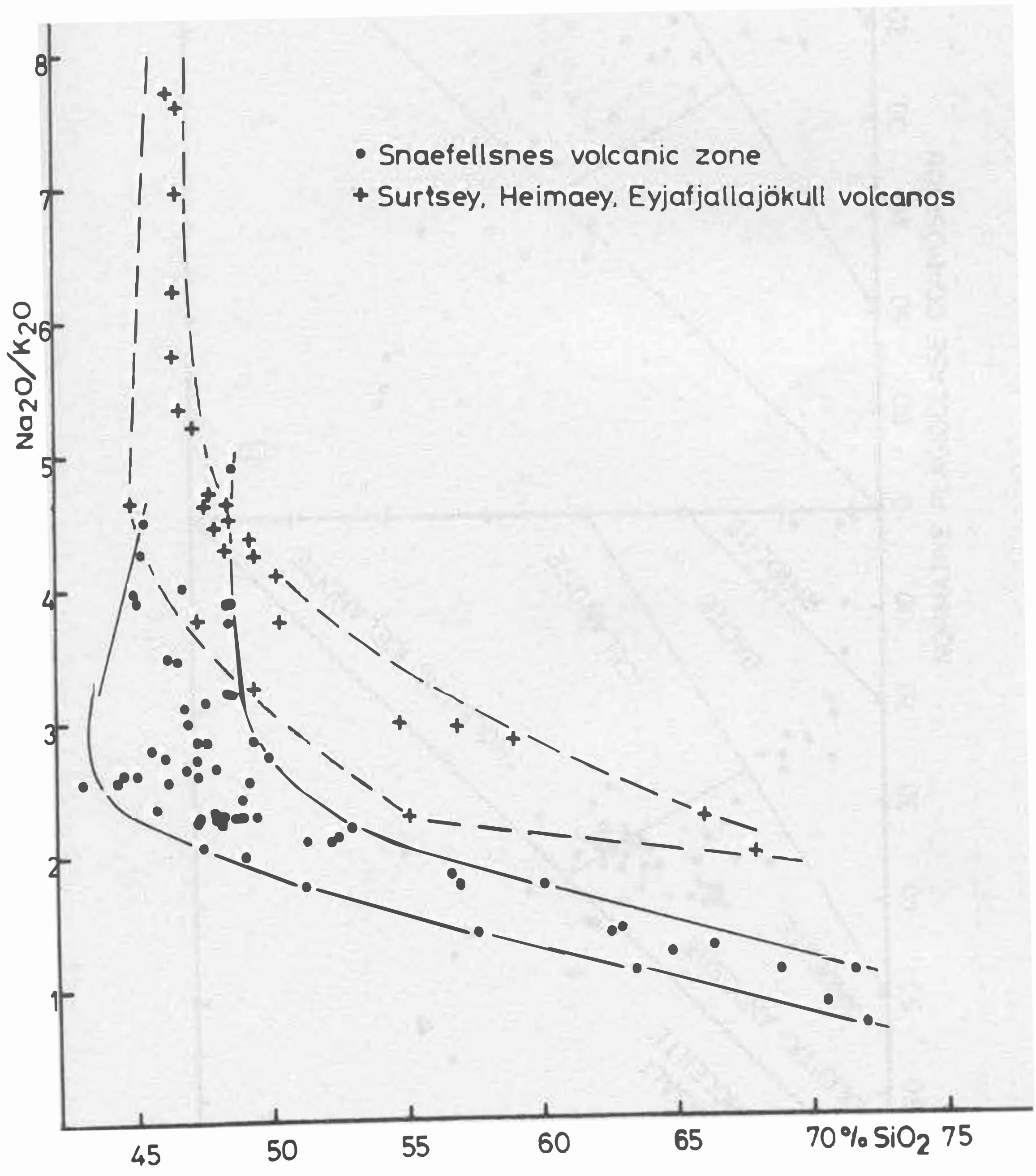
Fig. 5. The southern part of the Sudurland volcanic zone and the systematic distribution of rock types. The small stars show the sample locality of high-titanium tholeiites analysed from the area. The bigger stars at Katla and Eldgjá indicate the high-titanium nature of these volcanic complexes expressed in repeated eruptions of high-titanium tholeiites.

Fig. 6. The major rift swarms within the rift zones shown schematically. The bigger stars represent central volcanoes evolved on the rift swarms.
1 = Öræfajökull, 2 = Theistareykir,
3 = Námafjall-Krafla, 4 = Fremri námar,
5 = Askja, 6 = Kverkfjöll, 7 = Grímsvötn,
8 = Geirvörtur-Pálsfjall, 9 = Katla,
10 = Tungnafellsjökull-Hágöngur, 11 = Hekla,
12 = Kerlingarfjöll, 13 = Þjófadalir,
14 = Thórisjökull, 15 = Hengill. The small stars on the Reykjanes peninsula are rift swarms close to a central volcano stage, which already have evolved a system of high temperature hydrothermal activity.

Fig. 7. K_2O in tholeiites of the rift zones plotted against distance towards N and SW from Kverkfjöll, Central Iceland (see Fig. 6) showing the increasing K_2O-enrichment of the tholeiites towards the center of Iceland (from Sigvaldason et al., 1976).



ig. 1.


• Snaefellsnes volcanic zone
+ Surtsey, Heimaey, Eyjafjallajökull volcanos
Na_2O/K_2O
8
7
6
5
4
3
2
1
45
50
55
60
65
70 % SiO_2 75

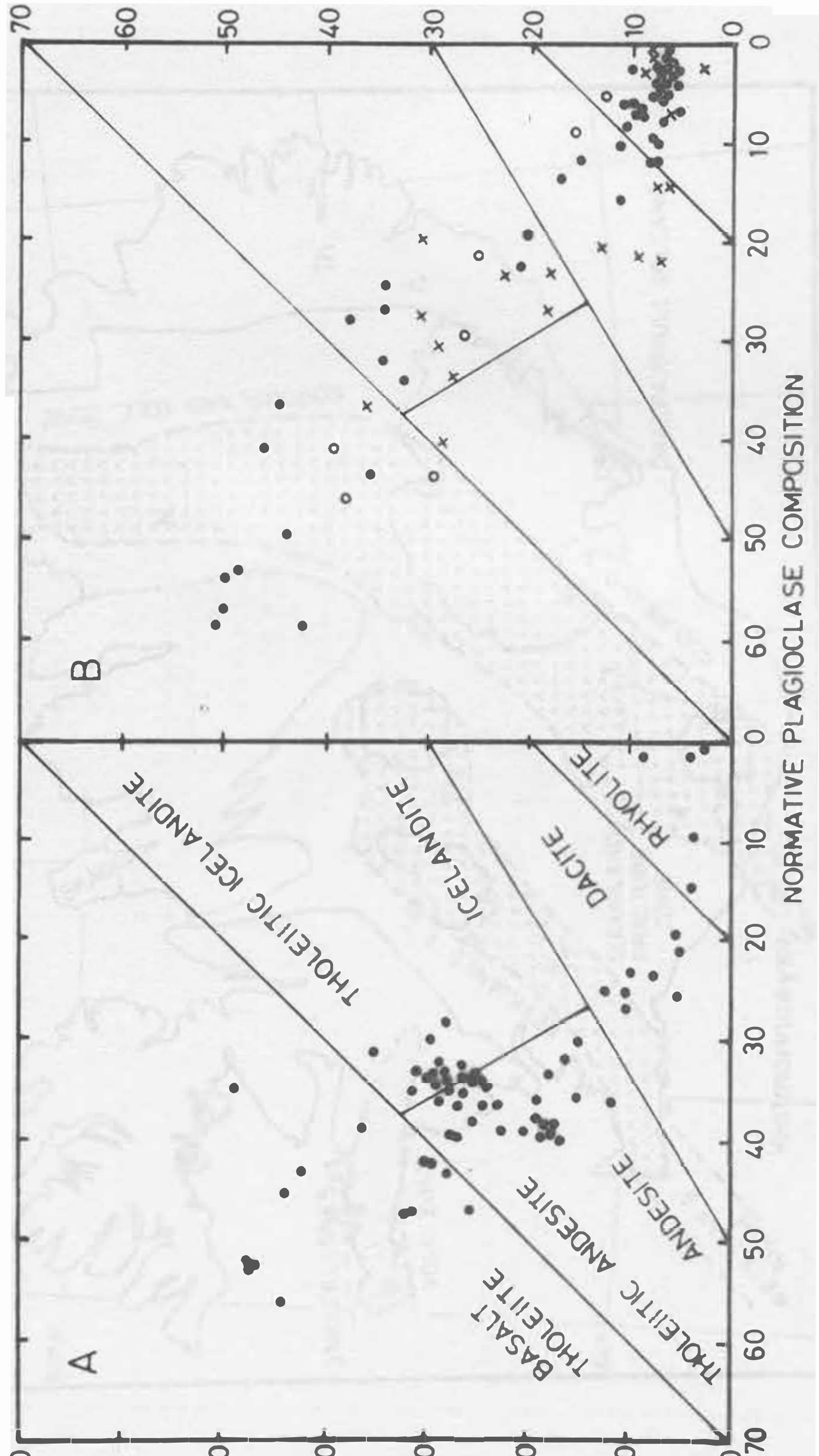

A
B
NORMATIVE COLOUR INDEX
NORMATIVE PLAGIOCLASE COMPOSITION
THOLEIITIC ICELANDITE
ICELANDITE
DACITE
RHYOLITE
BASALT THOLEIITE
THOLEIITIC ANDESITE
ANDESITE

Fig. 3.

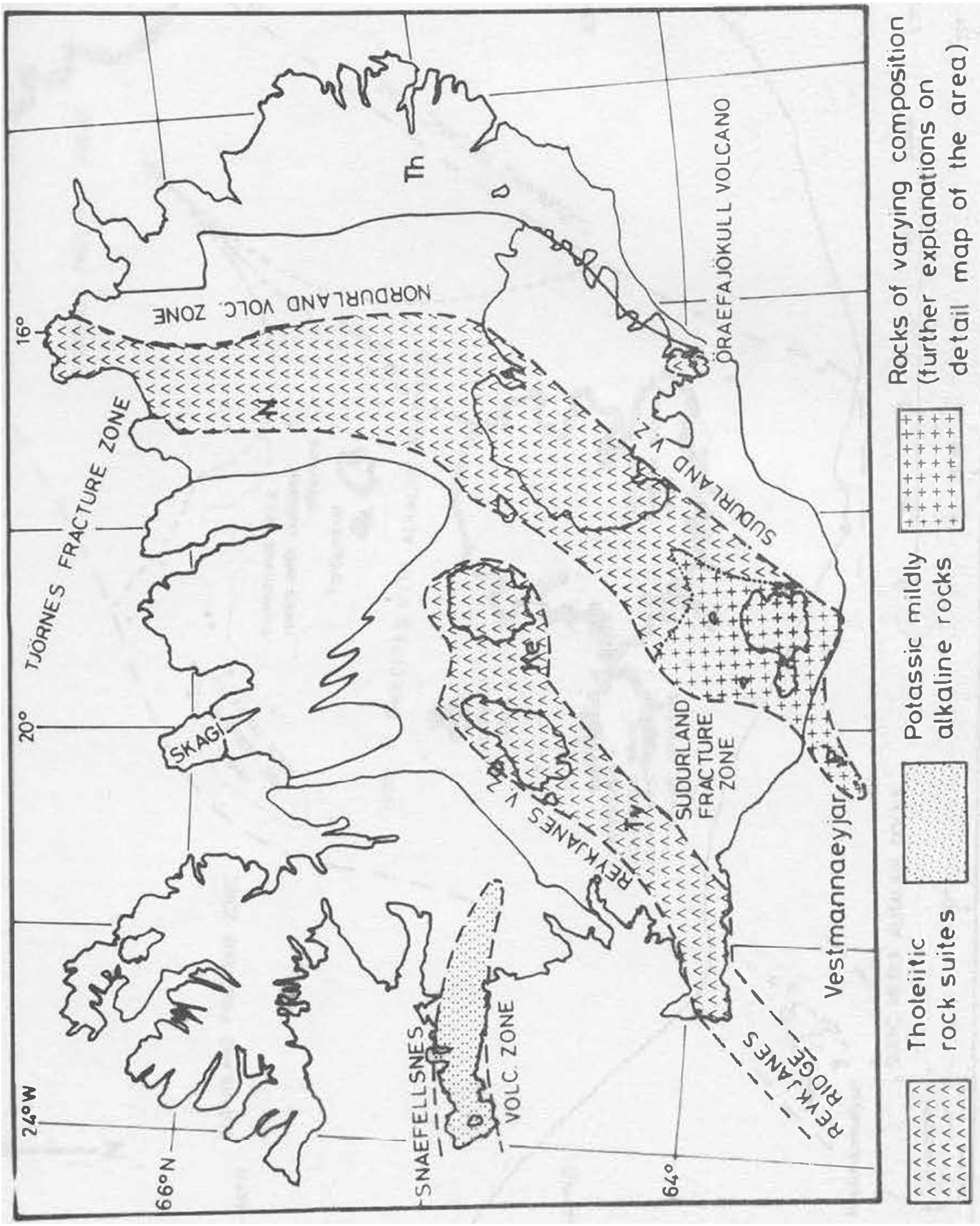
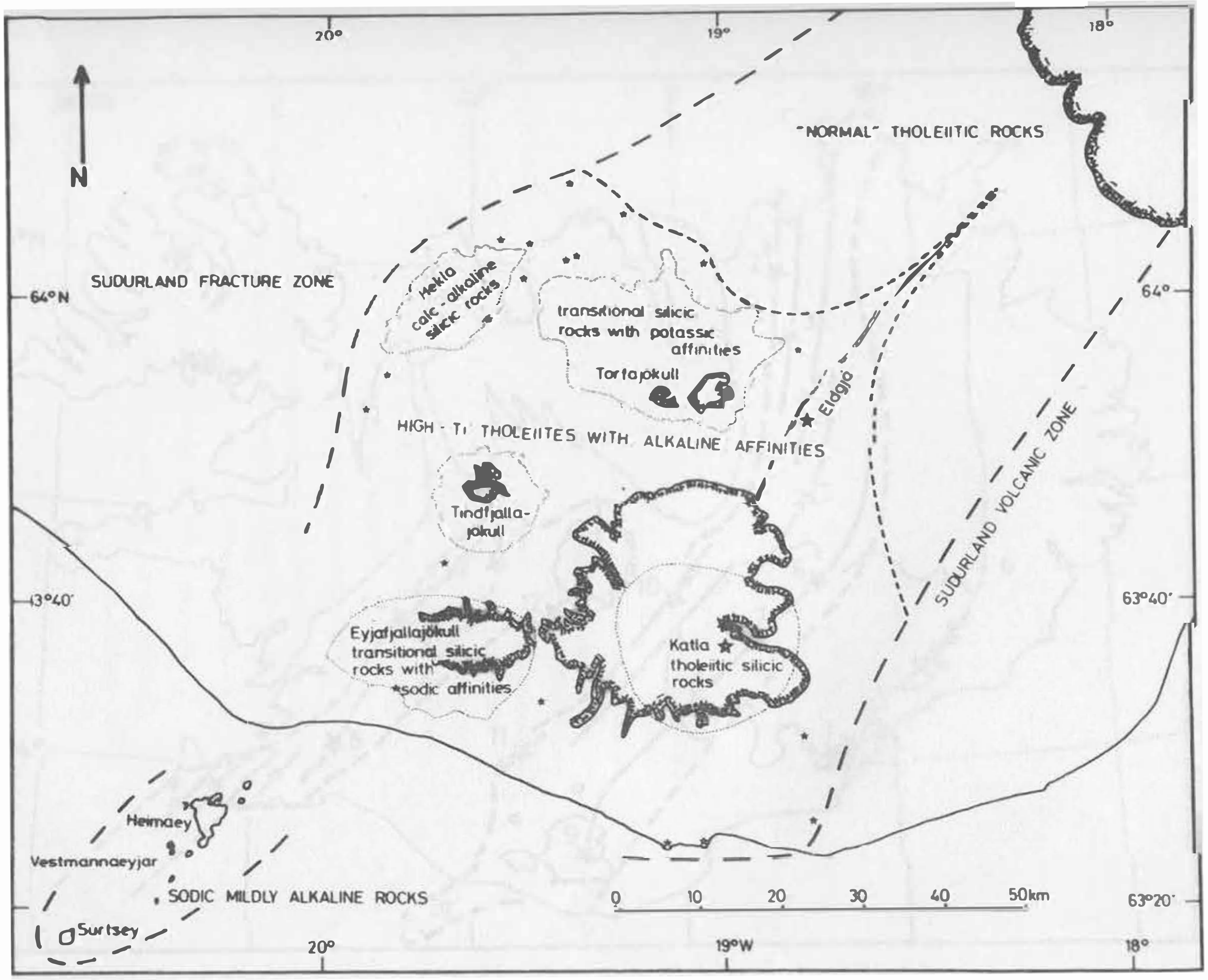

TJÖRNES FRACTURE ZONE
NORDURLAND VOLC. ZONE
16°
20°
24°W
66°N
64°
SKAGI
N
Th
ÖRAEFAJÖKULL VOLCANO
SUDURLAND V. Z.
Ne
REYKJANES V. Z.
SUDURLAND FRACTURE ZONE
Vestmannaeyjar
SNAEFELLSNES VOLC. ZONE
REYKJANES RIDGE
Tholeiitic rock suites
Potassic mildly alkaline rocks
Rocks of varying composition (further explanations on detail map of the area)

Fig. 4



20°
19°
18°
N
"NORMAL" THOLEIITIC ROCKS
SUDURLAND FRACTURE ZONE
64°N
64°
Hekla
calc-alkaline
silicic rocks
transitional silicic
rocks with potassic
affinities
Torfajökull
Eldgjá
HIGH-Ti THOLEIITES WITH ALKALINE AFFINITIES
Tindfjalla-
jökull
SUDURLAND VOLCANIC ZONE
63°40'
63°40'
Eyjafjallajökull
transitional silicic
rocks with
sodic affinities
Katla
tholeiitic silicic
rocks
Heimaey
Vestmannaeyjar
SODIC MILDLY ALKALINE ROCKS
0
10
20
30
40
50km
63°20'
Surtsey
20°
19°W
18°

Fig. 5.

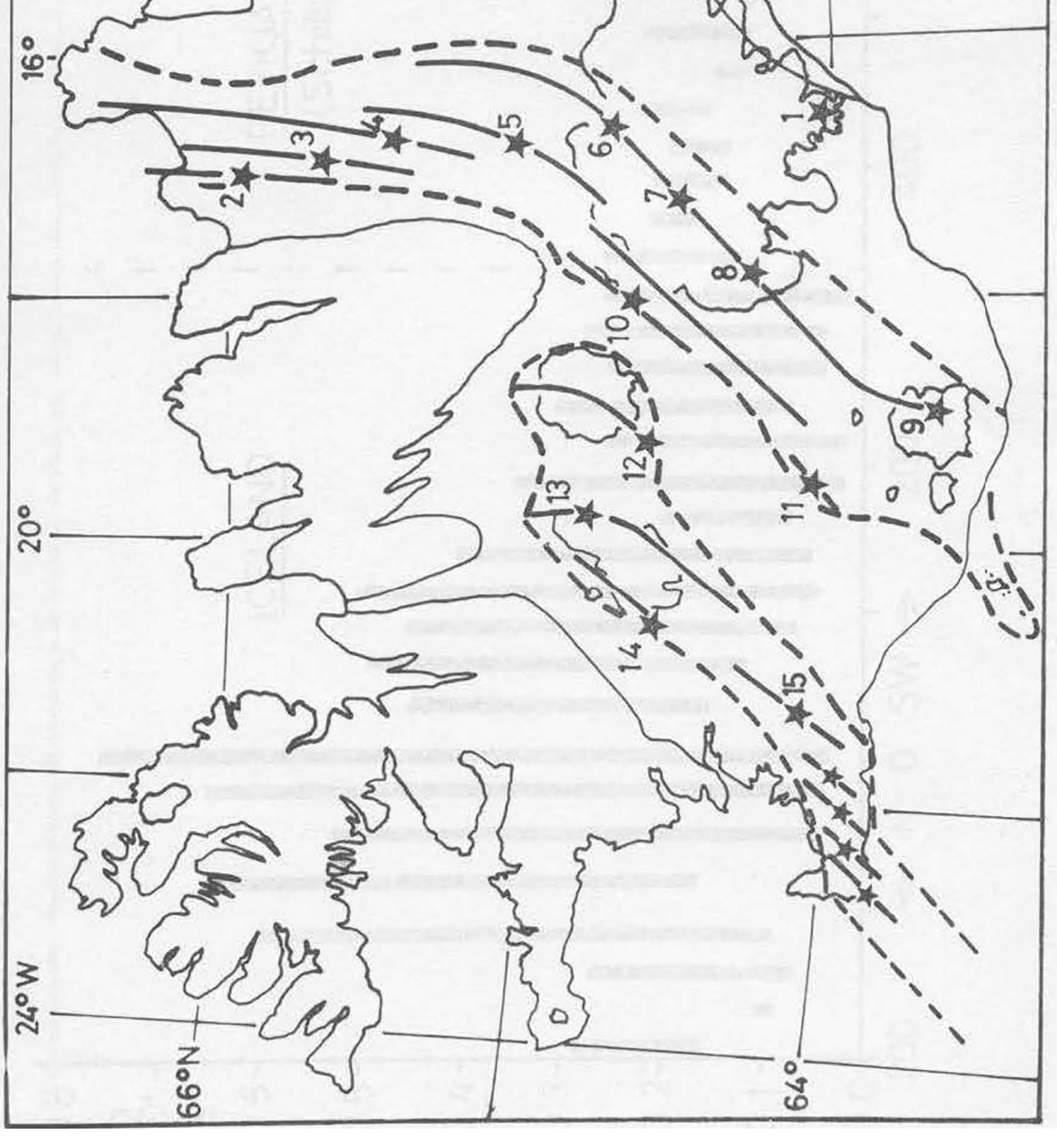
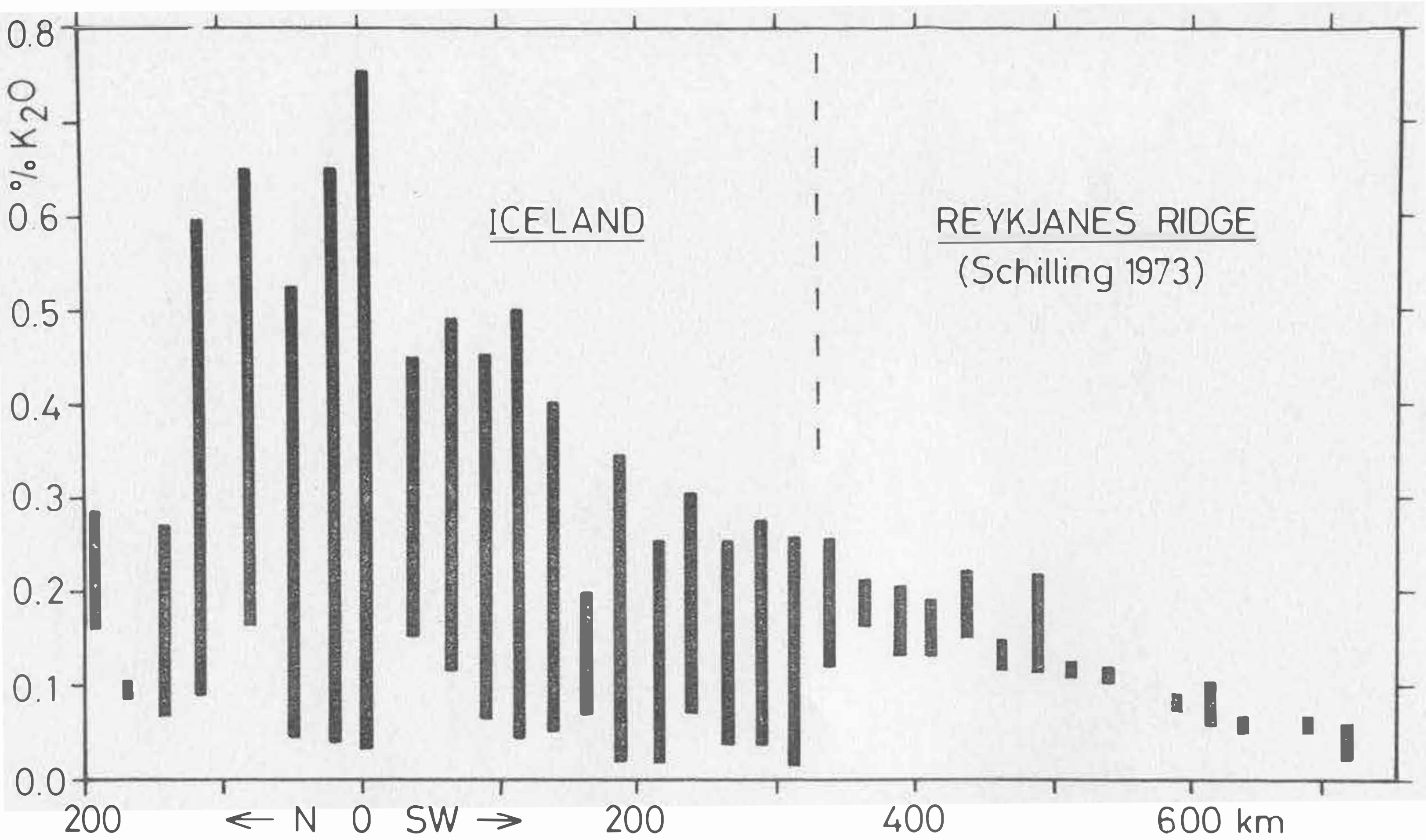


Fig. 6.


% K_2O
0.8
0.6
0.5
0.4
0.3
0.2
0.1
0.0
ICELAND
REYKJANES RIDGE
(Schilling 1973)
200
← N 0 SW →
200
400
600 km