NORDIC VOLCANOLOGICAL INSTITUTE 8903
UNIVERSITY OF ICELAND

THE 10th CENTURY ERUPTION OF ELDGJÁ, SOUTHERN ICELAND

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ABSTRACT

The eruption of Eldgjá, Southern Iceland, in 934 A.D. produced a large volume of transitional alkali basalt lava, typical of eruptions related to the Katla Volcanic System. This study considers some of the physical and geochemical characteristics of this fissure and its products. The crater row can be divided into two distinct crater types, cones, made up of scoria and spatter, and the elongate, steep-walled canyon or gjá from which the name of the volcano is derived (Eldgjá: fire-fissure). The primary volcanics making up both the scoria and spatter cones and the capping units of the gjá exhibit similar stratigraphic characteristics. Sections through both types of craters grade upward from scoria, to spatter, to agglutinated spatter, and to dense lavas. Physical characteristics suggest that the lavas are rheomorphic, produced by welding and secondary flowage of spatter, fed by intensive fire-fountaining. Field evidence also indicates that, for most of its length, the gjá was a feature of the local topography prior to 934 A.D. Revised estimates for the products of this eruption suggest a volume in excess of 14 km^3. Major element geochemistry of samples from along the crater row suggest the presence of a tholeiitic component in some of the lavas. A model is suggested which attempts to illustrate a mechanism for explaining this tholeiitic component.

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1. INTRODUCTION

1. 1. Program outline

This project was conceived as a reconnaissance survey of the physical and geochemical characteristics of the 934 A.D. eruption of Eldgjá, Southern Iceland. It was intended that the results of this study would be, given the time constraints of the funding program, of sufficient quality to generate a preliminary report to the Nordic Volcanological Institute (NVI) as well as a paper to be submitted to an international journal. More importantly, it was hoped that the results of this work would locate foci for future research to be undertaken either by the author or by subsequent research fellows at the NVI.

There is no doubt that this second objective has been achieved. As in many studies of this nature, many more questions than answers have been recognized. This paper is intended as a preliminary report, and the interpretations presented herein are by no means conclusive. Much more work is needed in the field, and this report is submitted as a record for future reference.

Two problems are addressed in this study. Firstly, the physical characteristics of the eruption and its products are reported and evaluated. Secondly, the major element geochemistry (MEG) of the primary volcanics is reported, and a model is presented that attempts to relate these results to the regional geology of Southern Iceland.

1. 2. Geologic and geographic setting

Two large volcanic systems dominate the recent geology in the study area (Fig. 1). The Grímsvötn Volcanic System is part of the Eastern Rift Zone (ERZ), and although the central volcano is beneath Vatnajökull glacier, the system has a historic subaerial fissure, Lakagígar, which produced the Skaftár Fires lava flows in 1783 A.D. (Thordarson, 1989). Similarly, the Katla Volcanic System has a subglacial central volcano. The caldera for the Katla central volcano resides beneath the southern part of the glacier Mýrdalsjökull. This system, which is part of the Eastern Transgressive Zone (ETZ), also contains a historic fissure eruption, Eldgjá. Both these systems have been extremely prolific in historic and prehistoric time, and both historic fissure eruptions produced large volumes of lava (on the order of 14 km^3) in relatively short-lived events. Several postglacial, although prehistoric, fissure eruptions have been recognized associated with each system. (Thordarson, 1989).

Documentation exists for both fissure eruptions. Records of the Skaftár Fires event are reasonably complete and detailed, but the eruption of Eldgjá is mentioned only in passing in Landnámasaga, the history of the settlement of Iceland.

> *" The settler Molda-Gnúpur took possession of all the land between Kuðafjót and Eyjará and the whole of Alftaver. At that time a large lake was there with good swan hunting. Molda-Gnúpur sold claims on this land to many newcomers and the district was densely populated until an earth- fire came. Then they fled westward to Höfðabrekka..."*

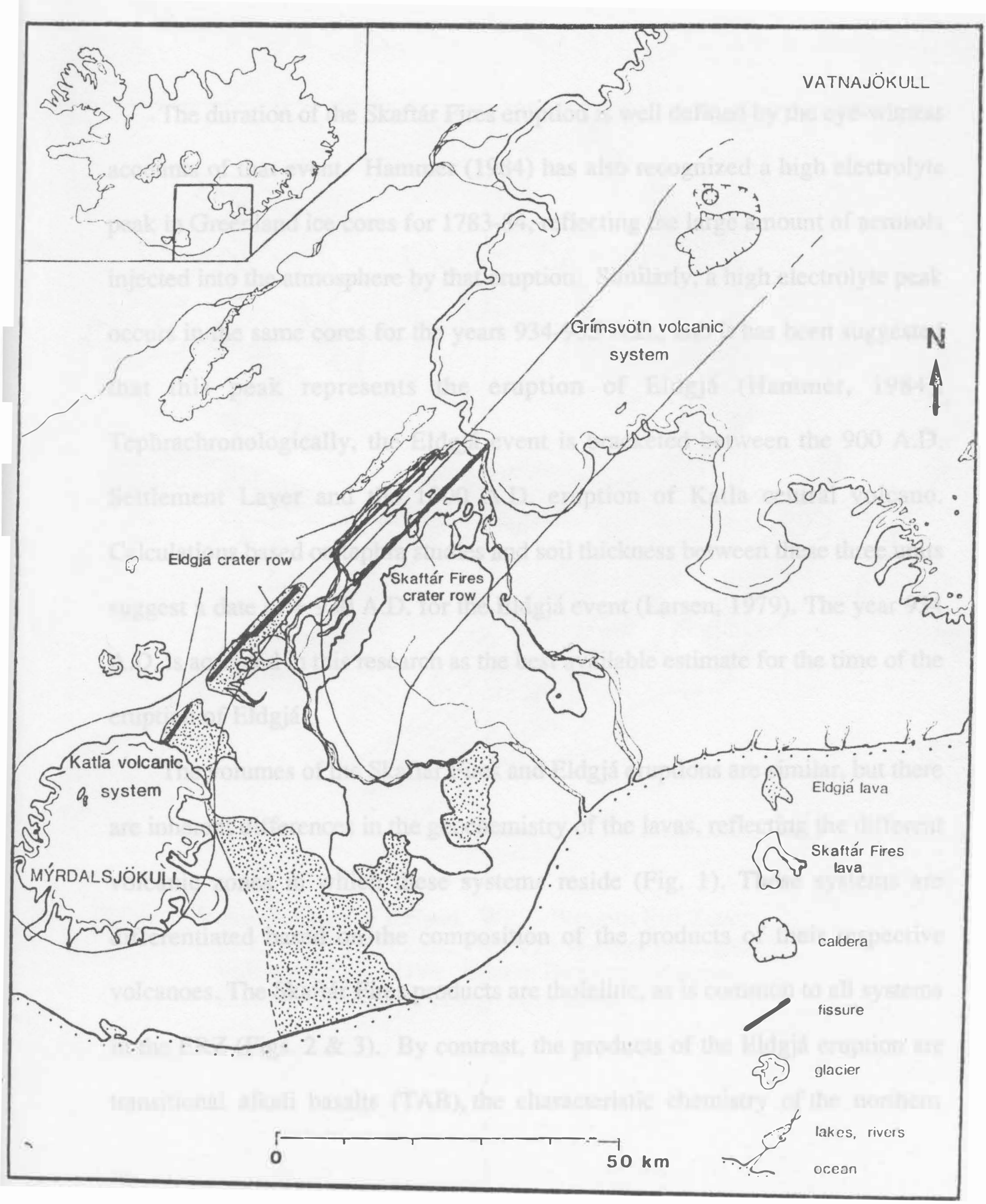


Figure 1. Volcanic systems in field area, Southern Iceland

The duration of the Skaftár Fires eruption is well defined by the eye-witness accounts of that event. Hammer (1984) has also recognized a high electrolyte peak in Greenland ice cores for 1783-84, reflecting the large amount of aerosols injected into the atmosphere by that eruption. Similarly, a high electrolyte peak occurs in the same cores for the years 934-935 A.D., and it has been suggested that this peak represents the eruption of Eldgjá (Hammer, 1984). Tephrachronologically, the Eldgjá event is bracketed between the 900 A.D. Settlement Layer and the 1000 A.D. eruption of Katla central volcano. Calculations based on tephra studies and soil thickness between these three units suggest a date of ≈ 930 A.D. for the Eldgjá event (Larsen, 1979). The year 934 A.D. is accepted in this research as the best available estimate for the time of the eruption of Eldgjá.

The volumes of the Skaftár Fires and Eldgjá eruptions are similar, but there are inherent differences in the geochemistry of the lavas, reflecting the different volcanic zones in which these systems reside (Fig. 1). These systems are differentiated based on the composition of the products of their respective volcanoes. The Skaftár Fires products are tholeiitic, as is common to all systems in the ERZ (Figs. 2 & 3). By contrast, the products of the Eldgjá eruption are transitional alkali basalts (TAB), the characteristic chemistry of the northern

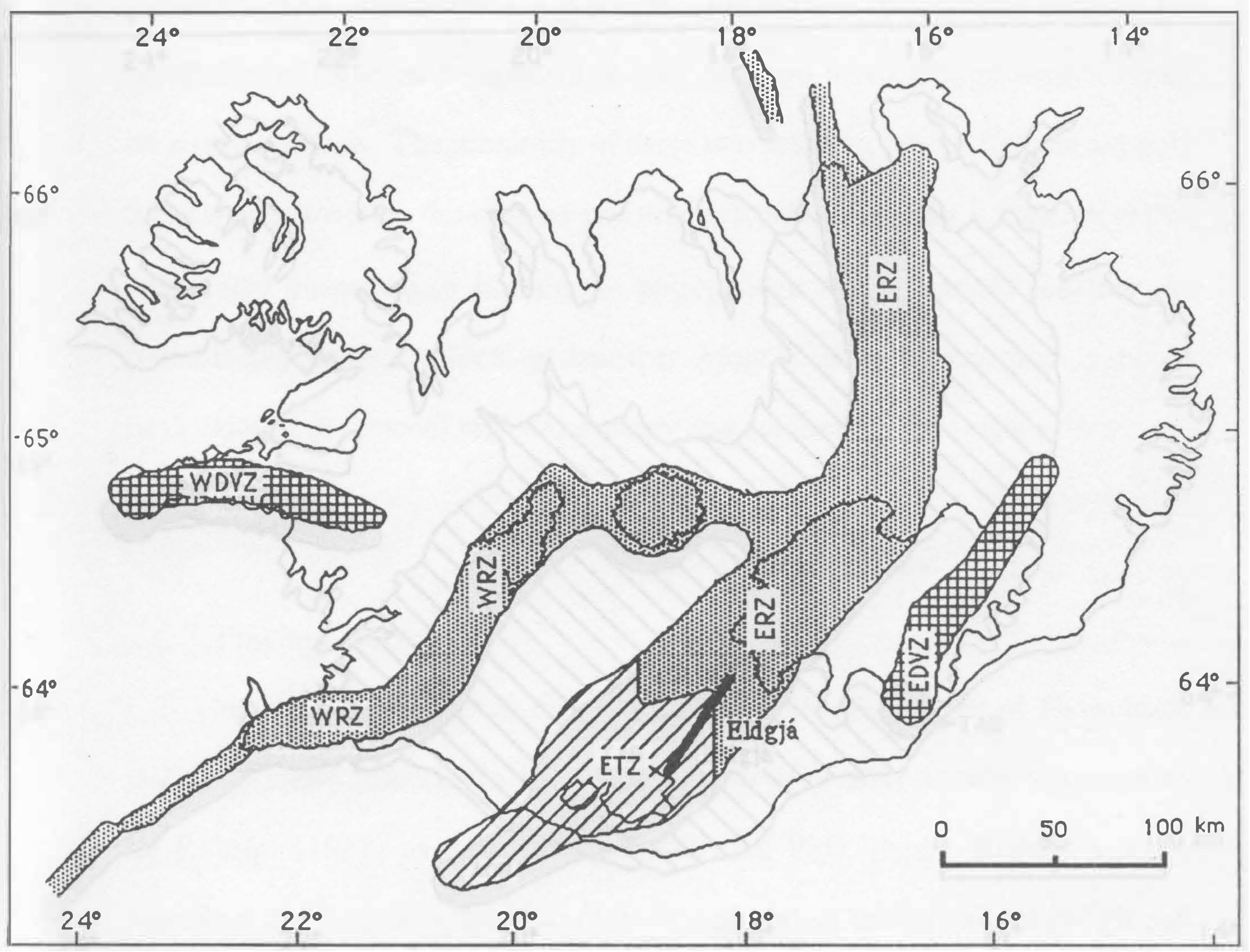


Figure 2. Volcanic zones of Iceland. WRZ- Western Rift Zone; ERZ- Eastern Rift Zone; WDVZ- Western Divergent Volcanic Zone; EDVZ- Eastern Divergent Volcanic Zone; ETZ- Eastern Trangressive Zone.

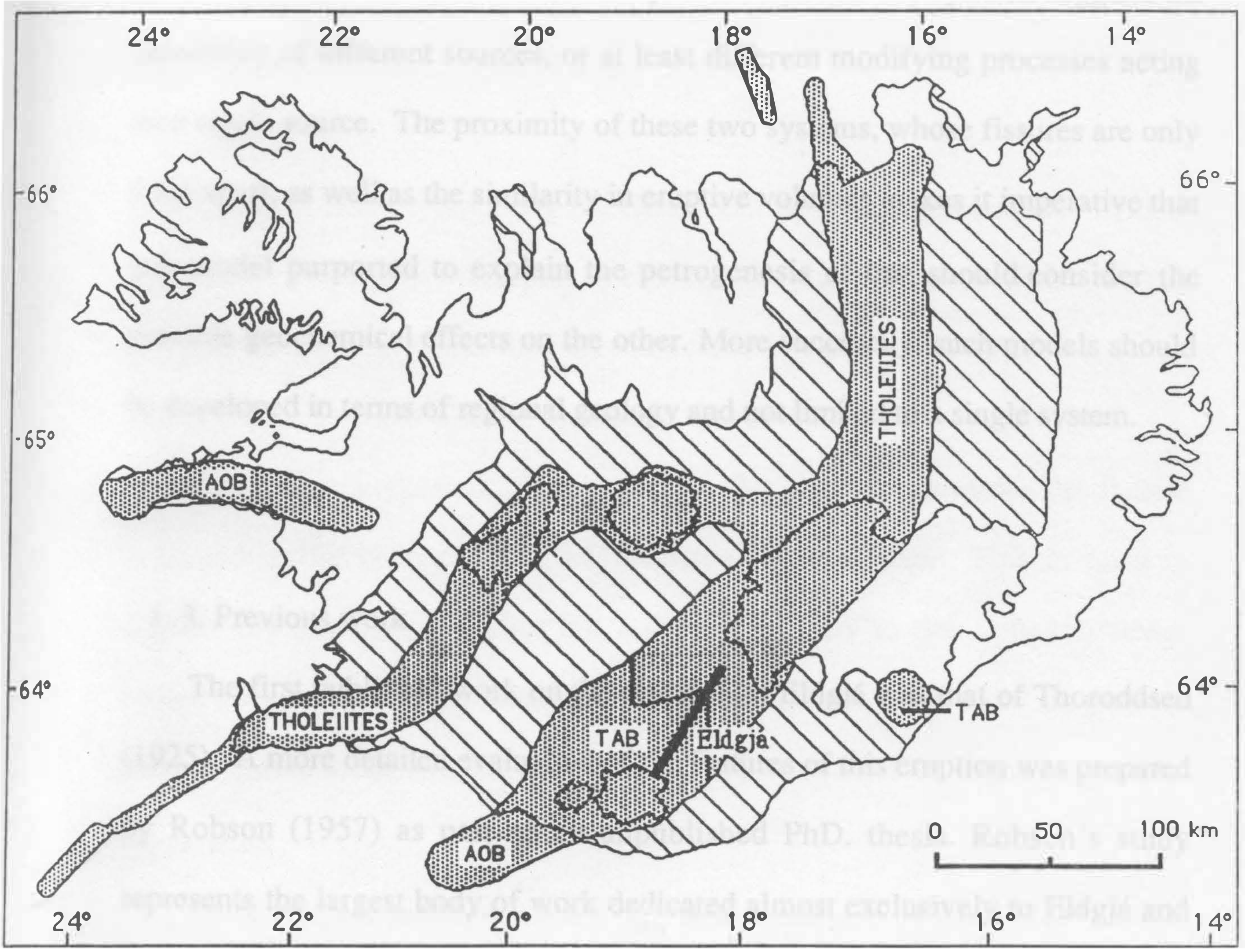


Figure 3. Composition of lavas in Iceland volcanic zones. AOB- alkali olivine basalt; TAB- transitional alkali basalt.

part of the ETZ. The difference in composition of these two systems suggests the possibility of different sources, or at least different modifying processes acting on a single source. The proximity of these two systems, whose fissures are only 5 km apart, as well as the similarity in eruptive volumes makes it imperative that any model purported to explain the petrogenesis of one should consider the possible geochemical effects on the other. More succinctly, such models should be developed in terms of regional geology and not limited to a single system.

1. 3. Previous work

The first published work on the eruption of Eldgjá was that of Thoroddsen (1925). A more detailed evaluation of the features of this eruption was prepared by Robson (1957) as part of an unpublished PhD. thesis. Robson´s study represents the largest body of work dedicated almost exclusively to Eldgjá and many of his observations are reflected in this research. Eldgjá has been included in several other studies of the general area, including those by Jakobsson (1979), Larsen (1979), Jónasson (Unpub. B.Sc. thesis, 1974) and Thórarinsson (1955).

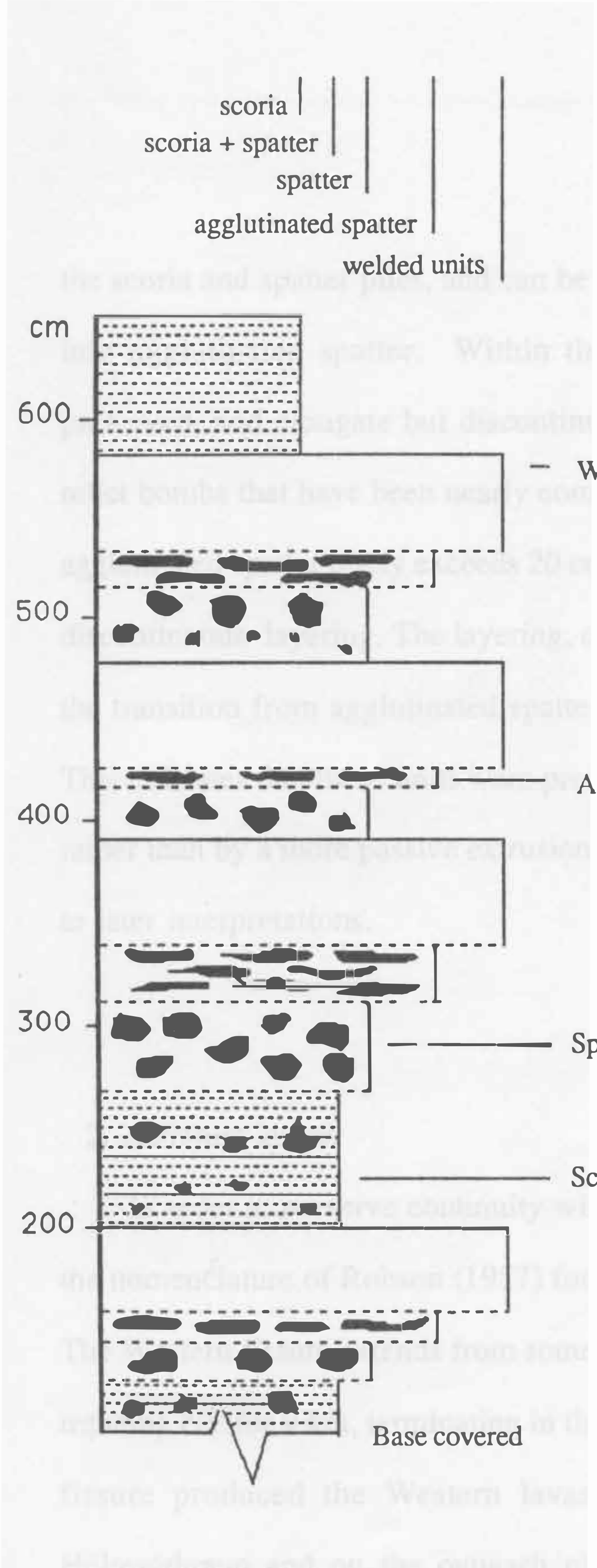
2. PHYSICAL CHARACTERISTICS

2. 1. Crater types

Although crater types along the fissure can be more rigorously subdivided, it serves the purpose of this report to classify them in two groups. First, the gjá, or fissure itself, from which the volcano´s name is derived (Eldgjá: fire-fissure), and, second, a series of discrete scoria and spatter cones.

It has been suggested, albeit casually, that the gjá resembles the fissure produced in the 1886 eruption of Tarawera, New Zealand. This in no way implies any genetic similarity, but rather refers only to the elongate, steep-walled canyon capped by primary volcanics. Significant differences are present, however, and these two craters can only be compared in terms of general appearance.

The scoria and spatter cones are rigorously described by Robson (1957) and only one representative section from this research is included here (Fig. 4). In general, these cones are made up of discrete, coarsening upward packages of variably oxidized red-to-grey scoria which grade upward into spatter, agglutinated spatter and dense lavas. This sequence is repeated in some cases as many as five times, and in most sections there is a capping unit of oxidized scoria. It should be noted that the lavas drape the topographic highs created by



Welded units- 35 to 50 cm thick. Grade upward from agglutinated spatter. Base often exhibits discrete cm scale layering. Units contain relict spatter bombs and discrete vesicular lenses that appear to be assimilated bombs.

Agglutinated spatter- Rarely more than 20 cm thick, containing flattened and very fluid appearing bombs. Grade upward into welded spatter and rheomorphic lavas.

Spatter- Generally coarsening upward units containing undeformed spatter bombs.

Scoria- Contains several discrete units, each coarsening upward. Entire unit also generally coarsens upward. Grades upward into spatter. Contains variably oxidized, red-to-gray and fresh black clasts, with little or no accessory lithics.

Figure 4. Section through scoria and spatter cone from Northern fissure.

the scoria and spatter piles, and can be seen to grade upward from and laterally into agglutinated spatter. Within the lavas, relict spatter bombs are well preserved, and elongate but discontinuous, highly vesicular patches represent relict bombs that have been nearly completely assimilated. The thickness of the agglutinated spatter rarely exceeds 20 cm , but often the base of the lavas exhibits discontinuous layering. The layering, on the order of a few cm thick, represents the transition from agglutinated spatter to rheomorphic spatter-fed lava flows. This indicates that these units were produced by intense fire-fountaining activity rather than by a more passive extrusion from a vent. This observation is critical to later interpretations.

2. 2. Fissure length

In order to preserve continuity with previous work, this study has adopted the nomenclature of Robson (1957) for the fissure segments and lavas (Fig. 5). The Western fissure extends from some unknown distance under Mýrdalsjökull, trending NE for 9 km, terminating in the bowl-shaped crater of Rauðibotn. This fissure produced the Western lavas, including those around Brytalækir, Hólmsárhraun and on the outwash plain of Mýrdalssandur. The topographic

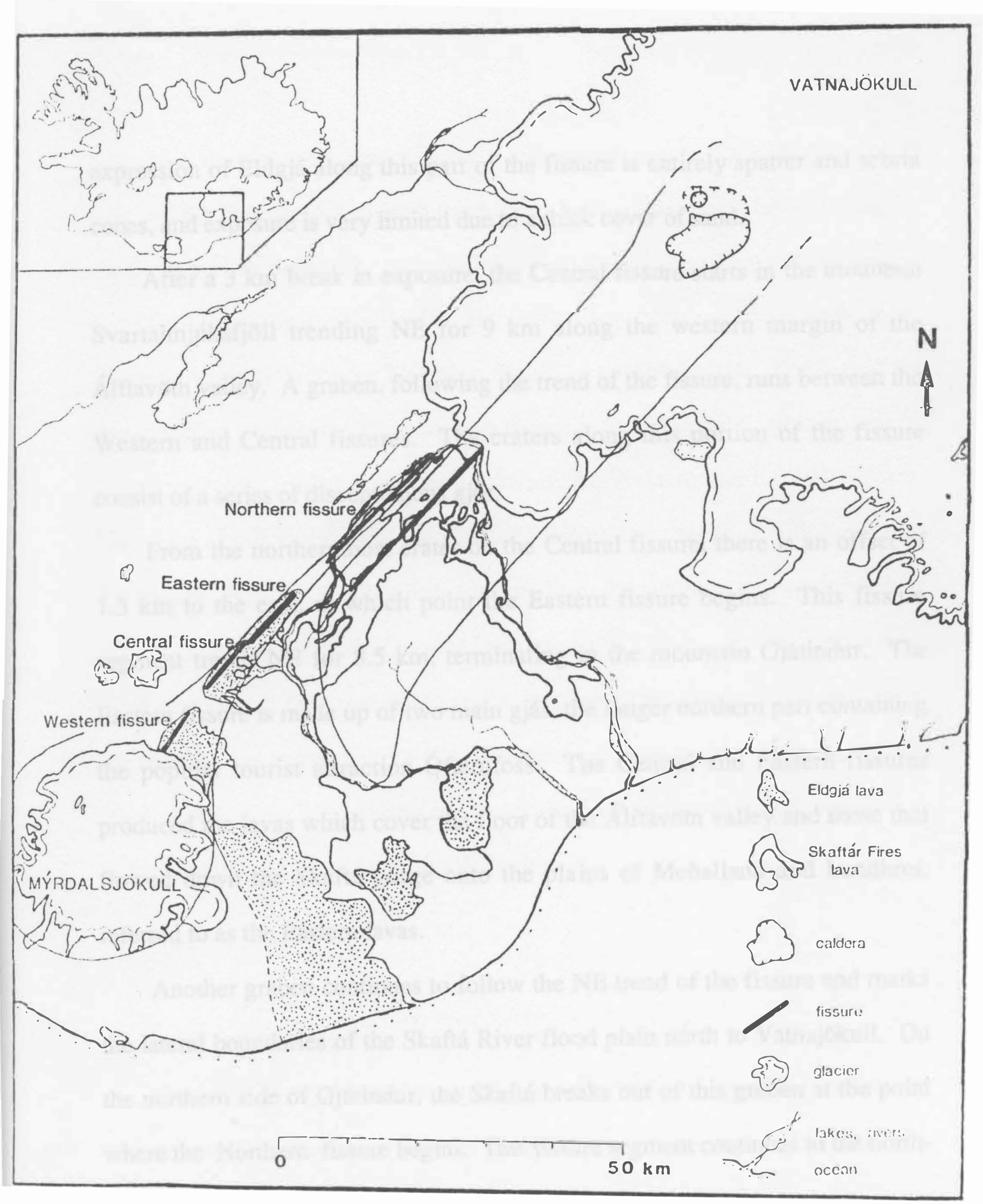


Figure 5. Fissure segments of Eldgjá.

expression of Eldgjá along this part of the fissure is entirely spatter and scoria cones, and exposure is very limited due to a thick cover of sand.

After a 3 km break in exposure, the Central fissure starts in the mountain Svartahnjúksfjöll trending NE for 9 km along the western margin of the Álftavötn valley. A graben, following the trend of the fissure, runs between the Western and Central fissures. The craters along this portion of the fissure consist of a series of discontinuous gjás.

From the northernmost crater on the Central fissure, there is an offset of 1.5 km to the east, at which point the Eastern fissure begins. This fissure segment trends NE for 8.5 km, terminating in the mountain Gjátindur. The Eastern fissure is made up of two main gjás, the longer northern part containing the popular tourist attraction Ófærufoss. The Central and Eastern fissures produced the lavas which cover the floor of the Álftavötn valley and those that flowed down the Skaftá gorge onto the plains of Meðalland and Landbrot, referred to as the Eastern lavas.

Another graben continues to follow the NE trend of the fissure and marks the lateral boundaries of the Skaftá River flood plain north to Vatnajökull. On the northern side of Gjátindur, the Skaftá breaks out of this graben at the point where the Northern fissure begins. This fissure segment continues to the north-east as a discontinous row of scoria and spatter cones for a distance of 19 km. All the lavas produced from these cones have subsequently been covered by the Skaftár Fires lavas. The entire length of the Eldgjá fissure exceeds 57 km.

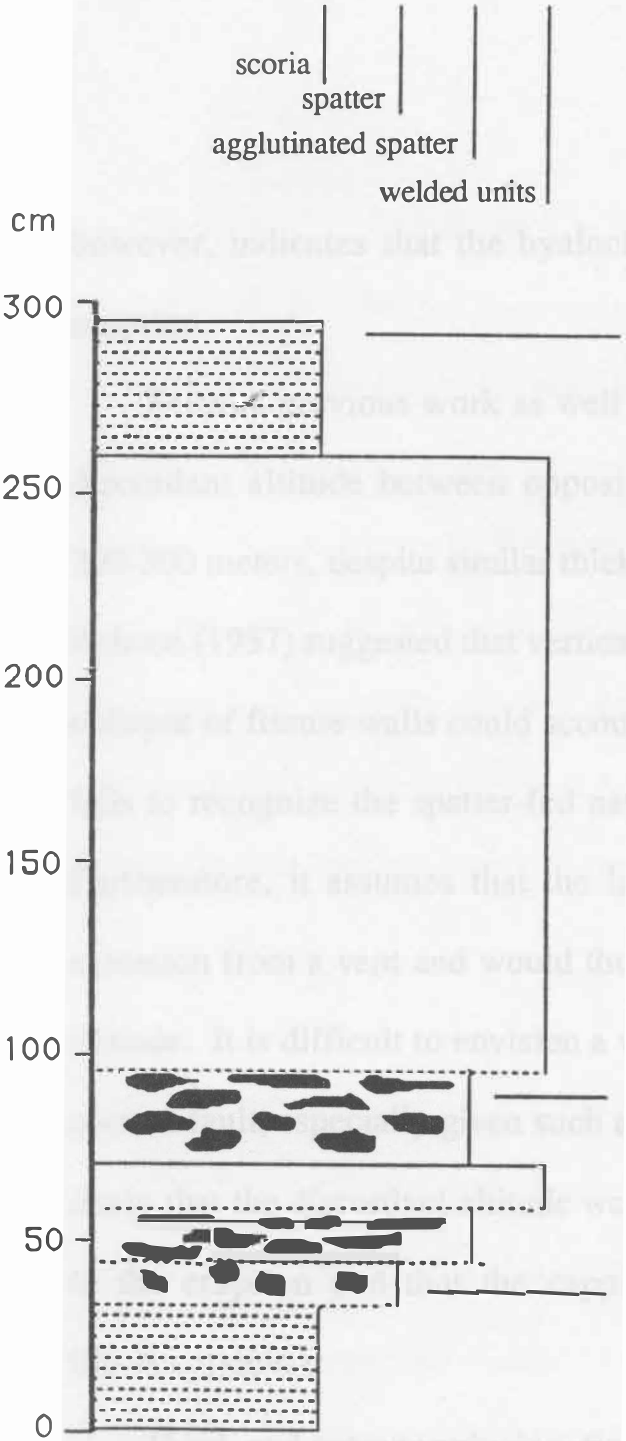
This length is nearly double that which has been reported, because no previous work includes the Northern fissure as part of Eldgjá. The reason for this omission is unclear. The Northern fissure is linked to the Eastern fissure by a graben similar to that recognized between the Western and Central fissures. The trend of this graben and the Northern fissure is continuous with the rest of the fissure. A single geochemical analysis from the southern part of this fissure segment is identical to other reported analyses of Eldgjá lavas. The tephra from these craters is at the same stratigraphic level as tephra produced by the rest of the fissure, and has a distinct Eldgjá texture, appearance and mineralogy. In other words, there is no reason not to regard these northern craters, referred to as Kambagígar, as part of the Eldgjá fissure.

2. 3. Gjá morphology

The gjá is characterized by a thick hyaloclastite base, capped by a relatively thin sequence of scoria and spatter including discontinuous welded and rheomorphic spatter units (Fig. 6). Sections on opposite sides of the gjá are generally very similar in thickness and appearance, although in some locations more welded units occur on one side or the other. Sections through the primary volcanics capping the hyaloclastite base are virtually identical to sections through the scoria and spatter cones (compare Figs. 4 & 6), as should be expected since they were both produced by the same eruption.

As mentioned earlier, there is a superficial resemblence of Eldgjá to Tarawera. While there is little doubt that the fissure at Tarawera is a primary volcanic feature created by the eruption of that volcano, this study indicates that the gjá of Eldgjá was in existence prior to 934 A.D. While most of the evidence for this assertion is equivocal when evaluated singly, taken as a whole they support this interpretation.

First, despite the large volume of hyaloclastite that has been removed from the crater and must be accounted for, there is virtually none of this material in any of the tephra. In several very small parts of the gjá, there is a higher percentage of hyaloclastite, including blocks up to one meter across, in the proximal tephra. Even in these locally restricted sections, however, the abundance of accessory lithics does not exceed 10% of the volume of the deposit. The conspicuous absence of accessory lithics in the majority of tephra sections,



Scoria- Variably oxidized, red-to-gray and fresh black clasts. Contain some bombs, but little or no accessory lithics.

Welded units- Dense rheomorphic lavas which contain relict spatter bombs and vesicular lenses which appear to be assimilated bombs.

Agglutinated spatter- Grade rapidily upward from spatter and into welded units. Length- to-thickness ratio increases upward.

Spatter- Generally coarsening upward, highly oxidized, undeformed spatter bombs, mixed with some scoria.

Section rests on a thickness of greater than 100 m of hyaloclastite

Figure 6. Section through primary volcanics in main gjá.

however, indicates that the hyaloclastite was not removed by the 934 A.D. eruption.

Second, previous work as well as this study have recognized the strongly discordant altitude between opposite sides of the gjá, often on the order of 200-300 meters, despite similar thicknesses of primary volcanics on either side. Robson (1957) suggested that vertical displacement along a fault and subsequent collapse of fissure walls could account for this discordancy. This interpretation fails to recognize the spatter-fed nature of the welded and rheomorphic units. Furthermore, it assumes that the lavas were produced by relatively passive extrusion from a vent and would thus have to have been emplaced at the same altitude. It is difficult to envision a vertical displacement of 300 meters along a normal fault, especially given such a short-lived, single event. It is much more likely that the discordant altitude was a feature of the existing topography prior to the eruption and that the capping volcanics were deposited by intense fire-fountaining.

Third, and most convincing, field evidence indicates that lavas exposed on the top of the gjá flowed away from the Eldgjá fissure. On encountering pre-existing river channels, these flows turned and flowed for some distance parallel to the fissure. Following the river channels, the lavas turned again back toward the fissure and flowed down into the gjá through deeply incised cuts in the hyaloclastite. In order for these incisions to be explained, the gjá must have been a part of the local topography prior to the eruption. There is no question that all the scoria and spatter cones, as well as locally restricted parts of the gjá, are primary volcanic features. While it is difficult to place time constraints on the development of the gjá based only on field relationships, the observations presented here strongly suggest that for most of its length, the topographic depression which follows the trend of the fissure is older than 934 A.D. and not a primary feature formed during the eruption of Eldgjá.

2. 4. Volume estimates

The only published, and generally accepted, estimate for the volume of this eruption is 9.3 km^3 (Thoroddsen, 1925). Robson (1957), however, concluded that the volume may well exceed 14 km^3. Table 1 presents estimates given by Thoroddsen, Robson and this work for the areal extent of the Eldgjá lavas. All three estimates are in agreement for the Eastern lavas. Most of the lavas in the outflow plain are covered by the Skaftár Fires lavas, but the areal extent is reasonably well constrained.

Table 1. Areal extent (km^2) estimates for the Eldgjá lava flows.

Eastern flows	Thoroddsen	Robson	This study
Syðri-Ófæra	3		
Alftavötn	17		20
Nyðri-Ofæra	3	30.6	10.5
Meðalland		41.9	41.9
Landbrot		112.5	115.6
Under Skaftár flows	347	198.7	176.8
Skaftá gorge	23		23
Totals	393	383.7	387.8
Western flows			
Brytalækir			36.9
Hólmsárhraun			93.2
Mýrdalssandur			215
Totals	300	430.2	345.1
Northern flows			
Skaftá River			47.5
TOTALS	693	813.9	780.4

There is, however, a significant difference in the estimates of areal extent for the Western lavas. The details of Thoroddsen´s estimate are sketchy, but it appears to underestimate the extent of lavas on Mýrdalsandur and around Brytalækir. Alternatively, several flows included in Robson´s estimate, which was based on more detailed mapping and mineralogy, have subsequently been tephrachronologically dated as being up to several thousand years old. The revised value presented in this work accounts for these discrepancies.

Neither previous work includes estimates for the Northern lavas. These are everywhere covered by the Skaftár Fires lavas, although exposures have been reported (Jónasson, 1974). Assuming that the gorge had the same dimensions as it does today, the value given here is legitimate.

Table 2 presents volume estimates for all the material produced by this eruption. For the Eastern flows, Robson´s estimate is somewhat larger because he assumes a greater average thickness for the material in the outflow plain. While many more sections through these lavas are needed to constrain this volume, the total must certainly be between 6.3 km^3 and 7.7 km^3. Differences in volume estimates for the Western lavas merely reflect the difference in areal extent used in each study. The volume of the Northern lavas could also be much better constrained by more sections, and the estimate presented here is thought to

Table 2. Volume (km^3) estimates for the Eldgjá lava flows.

Eastern flows	Thoroddsen	Robson	This study
Syðri-Ófæra	0.9		
Álftavötn	0.51		0.60
Nyðri-Ofæra	0.06	0.60	0.21
Meðalland		0.84	0.84
Landbrot		2.25	2.31
Under Skaftár flows	5.205	3.974	2.65
Skaftá gorge	0.46		0.46
Totals	6.325	7.674	7.07
Western flows			
Brytalækir			1.11
Hólmsárhraun			2.80
Mýrdalssandur			2.15
Totals	3.00	6.453	6.06
Northern flows			
Skaftá River			0.48
Tephra			0.60
TOTALS	9.325	14.1	14.2

be a minimum. Neither Thoroddsen nor Robson included estimates of the volume of the tephra produced by this eruption. Although work in this area is still incomplete, a reasonable value is 0.6 km^3 D.R.E. (G. Larsen, pers. comm. 1989). It follows that the volume of this eruption should be at least about 14 km^3 and may be closer to 16 km^3 because the thickness may be underestimated. The volume of the 934 A.D. eruption of Eldgjá is thus at least equal to, and may well exceed, that produced in the Skaftár Fires, which has been regarded as the largest basalt fissure eruption in historic time.

3. GEOCHEMICAL CHARACTERISTICS

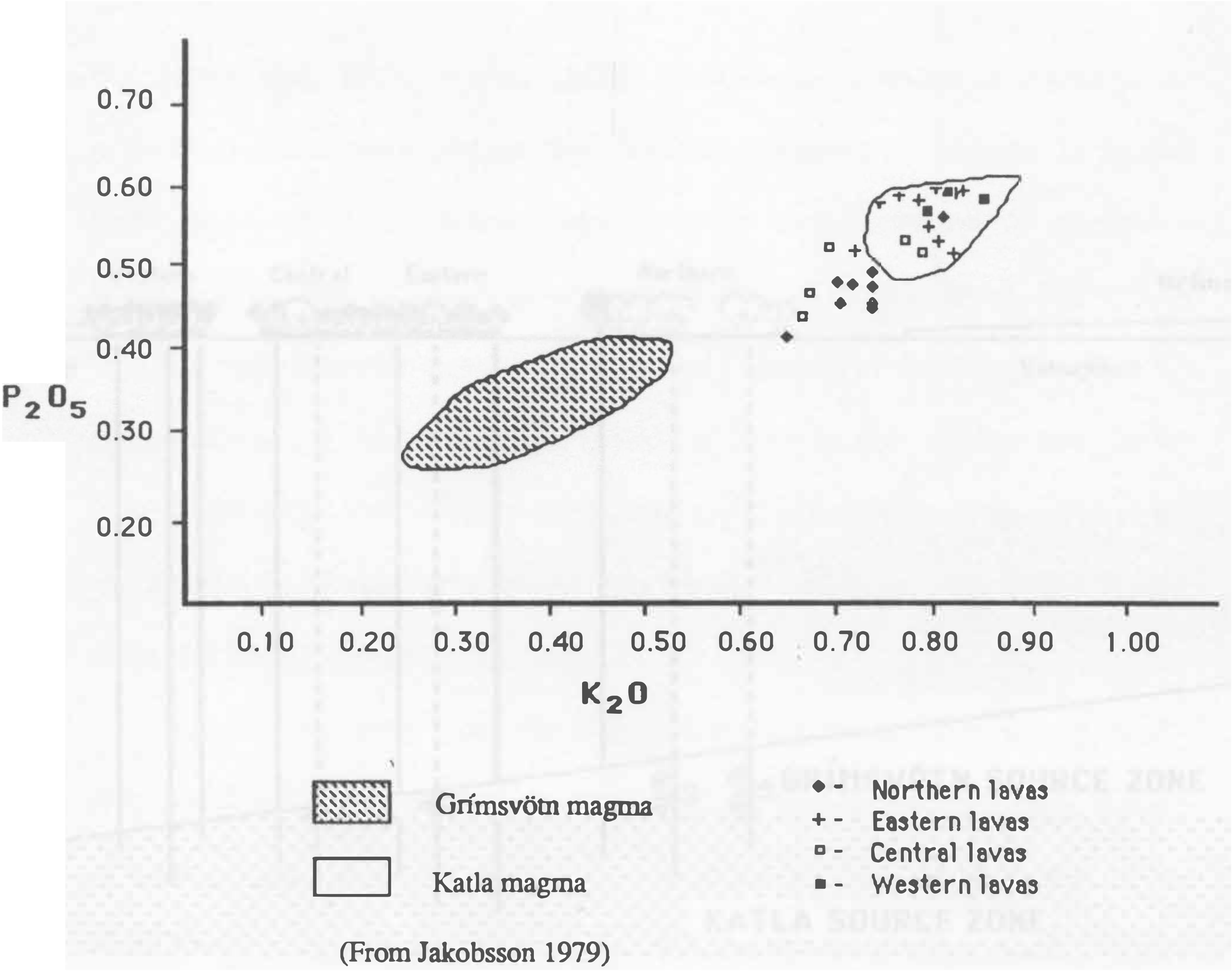
The products of the Eldgjá eruption are geochemically related to the Katla Volcanic system. Most samples collected during this research are chemically identical to the few previously reported Eldgjá analyses. MEG analyses of samples taken along the length of the fissure indicate that there is, however, some compositional variation. In terms of regional geology, this is significant in that the Skaftár Fires eruption produced a similar volume of lava that is, in all reported respects, homogeneous. Table 3 includes all complete MEG analyses

Table 3. Major element geochemistry of samples from Eldgjá.

Sample	SiO2	Al2O3	TiO2	MgO	MnO	FeO	Fe2O3	CaO	Na2O	K2O	P2O5	TOTAL
3-1	48.16	11.78	4.07	5.66	0.213	9.35	7.39	10.30	2.79	0.65	0.423	100.79
9-1	47.15	11.73	4.30	5.50	0.217	5.91	11.43	10.00	2.99	0.73	0.453	100.41
10-1	47.51	11.45	4.33	5.50	0.217	12.06	4.71	10.53	2.92	0.73	0.494	100.45
11-1	48.04	13.33	4.16	5.44	0.215	12.10	4.78	10.19	2.83	0.73	0.445	102.27
12-1	47.15	11.92	4.33	5.31	0.220	11.94	4.73	10.00	2.99	0.78	0.568	99.94
12-3	47.95	11.80	4.43	5.15	0.225	13.16	3.37	9.89	3.10	0.86	0.583	100.52
14-1	48.15	12.45	4.10	5.69	0.210	12.85	3.83	10.52	2.73	0.66	0.441	100.92
18-1	47.71	12.04	4.41	5.12	0.225	12.94	3.62	9.78	3.17	0.86	0.564	100.44
19-1	46.92	11.82	4.37	5.31	0.220	12.80	3.73	10.21	3.08	0.85	0.506	99.87
20-1	47.40	12.36	4.19	5.17	0.220	11.76	4.93	9.90	2.94	0.82	0.532	100.22
21-1	46.77	12.77	4.16	5.79	0.215	12.21	4.55	10.41	3.01	0.73	0.471	101.09
29-1	47.82	12.10	4.22	5.28	0.224	12.56	4.16	9.87	3.10	0.80	0.570	100.70
30-1	46.05	11.45	4.14	5.63	0.212	11.19	5.35	10.84	2.85	0.70	0.481	98.89
33-1	46.67	11.39	4.32	5.21	0.220	12.52	3.65	10.11	2.99	0.81	0.591	98.48
35-1	48.30	11.99	4.33	5.12	0.226	11.44	4.84	9.78	3.10	0.79	0.573	100.49
45-1	48.02	11.55	4.37	5.30	0.222	12.14	4.51	9.96	3.06	0.78	0.562	100.47
46-3	47.13	11.56	4.27	5.50	0.215	12.16	4.48	10.59	2.90	0.71	0.501	100.02
48-1	47.32	12.09	4.11	5.63	0.212	12.61	4.10	10.57	2.83	0.68	0.534	100.69
50-1	46.18	12.10	4.11	5.53	0.214	12.62	4.42	10.58	2.74	0.66	0.437	99.59
51-1	46.72	12.01	4.07	5.54	0.216	12.25	4.84	10.73	2.74	0.67	0.457	100.24

performed in this research. The variability can be seen in several oxides but is best illustrated by a covariation plot of P_2O_5 vs. K_2O (Fig. 7). The shaded area represents the compositional range of these oxides for the Grímsvötn Volcanic System, including the Skaftár Fires lavas. Similarly, the unshaded envelope encapsules the same values for the Katla Volcanic System. Most of the samples collected in this work fall within the Katla envelope, with a small population falling in the intermediate range between typical Grímsvötn and Katla compositions. All of the samples from the Western fissure, as well as most of those from the Central and Eastern fissures, are included in the typical Katla range. All except one of the Northern lavas, however, fall within the intermediate range. A few samples from the Central and Eastern fissures also have this intermediate chemistry. These intermediate lavas appear to have some tholeiitic component contaminating the TAB chemistry which characterizes the Katla system.

Defining a model which incorporates these data is somewhat premature, but at the same time such a model suggests specific work that can be undertaken to test this hypothesis. While there are certainly other possibilities, Figure 8 depicts a schematic model that illustrates most simply how the observed variability in the Eldgjá products can be explained. U/Th abundances



(From Jakobsson 1979)

Figure 7. Covariation plot of P_2O_5 vs. K_2O.

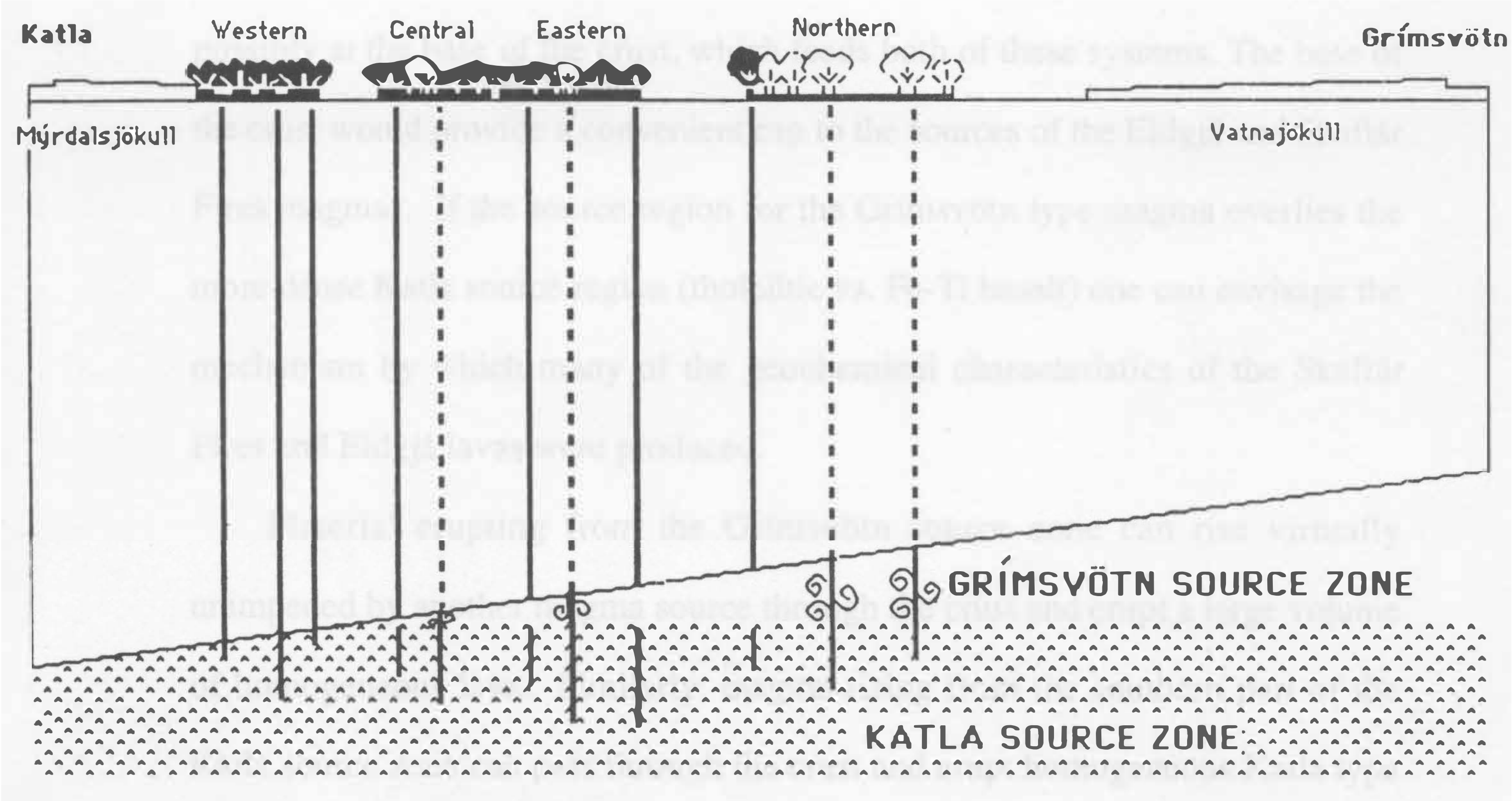


Figure 8. Tentative schematic model of Katla and Grímsvötn source zones and their relationship to the geochemical variability observed in the Eldgjá products (see text for details).

(O. Sigmarsson, pers. comm., 1989) and volume constraints discount the probability of a shallow magma chamber feeding either the Eldgjá or the Skaftár Fires eruptions. There must then be some large reservoir or reservoirs, possibly at the base of the crust, which feeds both of these systems. The base of the crust would provide a convenient cap to the sources of the Eldgjá and Skaftár Fires magmas. If the source region for the Grímsvötn type magma overlies the more dense Katla source region (tholeiitic vs. Fe-Ti basalt) one can envisage the mechanism by which many of the geochemical characteristics of the Skaftár Fires and Eldgjá lavas were produced.

Material erupting from the Grímsvötn source zone can rise virtually unimpeded by another magma source through the crust and erupt a large volume of homogeneous lava. Similarly, magma rising from the southern part of the Katla source zone can pass through the crust and erupt homogeneous Katla type lavas. In the region where the Grímsvötn source overlies the Katla source, however, magma rising from the lower source zone has the opportunity to mix with and assimilate Grímsvötn-type tholeiite prior to eruption. The likelihood of mixing increases northward as the Grímsvötn source region is enlarged closer to the central volcano. Mixing models indicate that the intermediate type Eldgjá magma can be produced by a 50/50 to 60/40 ratio of typical Katla to Grímsvötn magma, at least in terms of MEG. If the outcrop of Grímsvötn-type volcanoes, which define the Grímsvötn system (see Fig. 1), can be regarded as the southern limit of the Grímsvötn source reservoir, this same margin would mark the southernmost outcrop of Eldgjá lavas with the mixed character. This model is, of course, speculative and suggests much more intensive investigation is necessary in order to develop a viable model.

4. DISCUSSION

In terms of the amount of research necessary in this part of Iceland, this work barely succeeds in scratching the surface. It does, however, suggest several foci of future study which will go much further into unravelling the geologic complexities of this region. The volume estimate presented here can be greatly refined simply by measuring sections through the Eldgjá lavas on Mýrdalssandur, Landbrot, Meðalland and the Skaftá River. Research on the distribution of tephra would also generate a more tightly controlled volume estimate for these products. Much more work is required as regards the geochemical variabilty recognized in this research. Phenocryst chemistry and bulk-rock trace element and isotopic studies would be invaluable tools for testing the model suggested here.

The Eldgjá-Katla volcanic system provides an excellent opportunity for research detailing the development of a propagating rift zone. The occurrence of a tholeiitic component in these transitional alkali basalts may well represent the onset of a normal rifting episode or the encroachment of the ERZ into the ETZ of Southern Iceland. Fortuitously, Eldgjá appears to be recording the transition from a propagating rift zone to a typical mid-ocean rift zone. If such is the case, future work in this area is critical to defining the nature of regional tectonics not only in Iceland, but in any rifting environment.

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