Some Liparite Dykes from Rauðhellar in Mórsárdalur, Iceland

(*Paper from the IV Danish-Icelandic Expedition*)

by

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Abstract

In Morsárdalur in Southeastern Iceland a group of liparitic dykes have been encountered. The main rock types have been examined and a new chemical analysis carried out. The composition of the rock justifies that it is classified as a rhyodacite. The author assumes that the Morsárdalur rocks as well as the other Icelandic liparites consist of through fusion regenerated sialic material from a subbasaltic substratum.

During the fourth Danish-Icelandic expedition in 1936 whose main purpose was to study the Grimsvötn volcanic site in Vatnajökull and the Palagonite system of southern Iceland, reconnaissance trips were made to various regions, some of which lie somewhat out of the way. Among others Mórsárdalur in southeastern Iceland was visited. As fas as I have been able to ascertain, literature does not give any information on the intrusive liparitic rocks which crop out here. Consequently I have found it worth while to examine a small collection of these rocks which I made during our stay.

When travelling north from the farm Skaftafell into Mórsárdalur one cannot help noticing among the innumerable pebbles covering the valley bottom an appreciable number of light liparites and now and again a greenish obsidian. On the northwestern side of the valley, in the mountain wall of Rauðhellar I succeeded in finding at any rate some of these rocks *in situ*, viz. as dykes.

I climbed the lower part of Rauðhellar, northeast of Bæjarstadarskógur, through the southernmost of the steep ravines, which here cut into the mountain. The dip of strata was measured at 12° N NE and seems to be almost the same on the other side of the valley.

Rauðhellar consists in its lower part of basalts of "plateaubasaltic habit", some of the flows contain zeolite filled pores, others not. At an altitude of 150 m. an indurated moraine with a reddish matrix and a thickness of 5 to 6 meters was encountered (NOE-NYGAARD, 1953); still higher up another indurated moraine with a yellowish brown matrix was observed.

The basalt sequence is cut by a number of thin, vertical dykes consisting of basalt; their strike is SW–NE and their thickness varies for 1 to 4 m. The dykes show a marked columnar jointing and possess along their contacts a narrow glassy band.

Besides the basalt dykes another dyke system is developed, with roughly the same strike but a flat dip, viz. ab. 30° towards northwest. The lowermost dyke I found was 1.5 m. thick; it had an obsidian belt of a greenish colour along its contacts, its thickness was abt. 3 cm., the rest of the dyke was built up of a light, greyish green liparite with a very pronounced lineation. Somewhat higher up I found another dyke which entirely consists of a porphyric greenish obsidian. In the upper, very steep wall of the mountain an additional number of dykes can be seen, they were, however, regrettably not visited in the field. A sharpedged, fresh boulder from the highest point I reached in the ravine may serve to show what may be expected higher up.

Two more rocks were examined, namely a porphyric obsidian and a greenish white agglomerate. They were collected as pebbles in Kjóarbækur in front of Rauðhellar. It is very likely that they belong to the same intrusive series as the dykes in this mountain, although they may rather have come from Kjós or from Miðfell than from Rauðhellar.

Central part of lower dyke (sample no. 21) Without Nicols the rock appears as a glass containing thin needle shaped microliths of aegirite, a few feldspar and single aegirite phenocrysts and some small, irregular oregrains. With crossed Nicols the rock appears with an almost microgranophyric texture, wherein numerous small rounded quarts grains are easily seen. The original plagioclasephenocrysts are rather altered, but nearer to the contact where the rock contains less quartz they are fresher. In one of these plagioclases the an-content was found to be 28% in the core and 21% in the outer zone, i.e. oligoclase.

Glassy contact of lower dyke (No. 22). The boundary between the crystallized central part and the glassy outer part is sharp, in places the phenocrysts on either side show rupture phenomena. Flow-lines are locally well developed in the glass which otherwise is impure and shows incipient devitrification, large spots of spongy quartz of later formation impregnate the rock. Further, sharpedged fragments of basaltic mylonitic material occur. Phenocrysts of plagioclase have the composition oligoclase/andesine, as measured on the U-stage in two separate grains:

1. 29% an, 2. 30% an.

A small number of pleochroic, green pyroxene phenocrysts proved to be aegirite with the following constants[1]:

$N_\gamma > 1.775 \pm 0.005$ $N_\gamma - N_\alpha > 0.039$
$N_\beta = 1.752 \pm 0.010$ Spec. gravity > 3.3
$N_\alpha < 1.736 \pm 0.005$

Further some almost automorphic grains of black ore occur as phenocrysts.

[1]) I am grateful to Mr. HARRY MICHEELSEN who carried out the measurements.

Fig: 1. Central part of lower dyke, Rauðhellar. || Nicols. 130×. Single phenocryst and thin needles of aegirite. CHR. HALKIER phot.

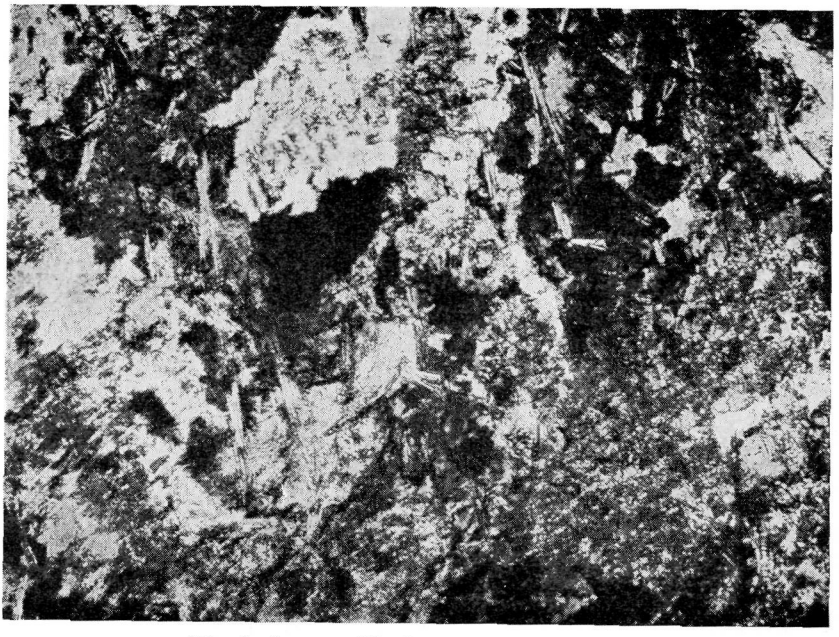

Fig: 2. Same + Nicols. CHR. HALKIER phot.

Porphyric obsidian from second dyke (No. 23). The rock is quite filled with very small, quite indeterminable crystallites; flow-lines are marked as bands with closer packed crystallites. A considerable number of plagioclase phenocrysts, abt. 1 mm. long with very pronounced automorphy is seen in these bands together with automorphic grains of black ore; both minerals may show corrosion embayments. Besides the said minerals a few grains occur of an almost colourless, weakly pleochroic orthorhombic mineral which was considered an orthorhombic pyroxene primarily. The following constants were determined:

$N_\gamma = 1.758 \pm 0.003$ $\quad N_\gamma - N_\alpha \geqq 0.027 \pm 0.003$
$N_\beta = 1.745 \pm 0.004$ $\quad 2V_\gamma = 68° \quad r > v$
$N_\alpha = 1.731 \pm 0.004$

The refringence is too high for any common orthorhombic pyroxene whereas it fits pretty well with hyalosiderite in the olivine series although the birefringence in that case would be remarkably low. Only few grains were available and unhappily the main thinsection came to nothing during our work with it in the laboratory. A single almost chloritized phenocryst of rounded shape may once have been olivine. The an-content of the plagioclase was measured at

37% an and 34% an respectively

in two twinned phenocrysts, i.e. andesine.

Loose obsidian block from upper end of ravine (No. 24). The rock is very similar to No. 21 but contains some irregular patches of calcite. The plagioclases are fairly well preserved. The an-content was determined in the core and in an outer zone to

29% an and 20% an respectively,

i.e. oligoclase. An outer brim is found now and then which shows no twinning, it has $2V_\alpha = 52°$ corresponding with anorthoclase, but the quadrille structure typical for this mineral is lacking. What can be seen clearly is that the plagioclase-twinning dominating the greater part of the grain in core and outer zone fades out and is followed by an outer brim of another feldspar.

I have not been to determine the small feldspars of the devitrified grundmasse.

Loose block, porphyric obsidian (No. 25). The obsidian which is greenish due to inclussions of aegirite needles is very similar to the obsidian in the Rauðhellar-dykes. The an-content of the plagioclase phenocrysts is, however, a little higher. Four individuals were measured on the U-stage with the following result

1: 26%, 2: 28%, 3: 34%, and 4: 36%,

i.e. oligoclase/andesine.

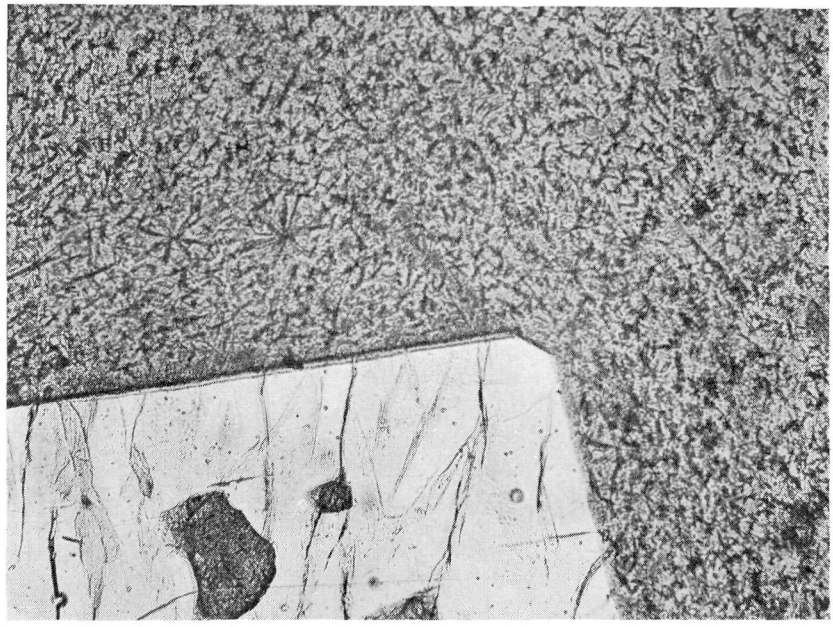

Fig: 3. Porphyric obsidian, *Kjoárbækur*. || Nic. 45×. Note stellar arrangements of microlites above big plagioclase phenocryst. CHR. HALKIER phot.

Loose block, liparitic agglomerate (No. 26). The light coloured agglomerate contains a considerable number of brown basaltic glass grains and bigger, porous inclusions of more or less devitrified glassy basalt up to several mm. across.

A new chemical analysis has been carried out by Miss ME MOURITZEN on a sample from the central part of the lower dyke in Rauðhellar. The result is shown in table 1 together with analyses of some related rocks from other Icelandic localities.

There is no great difference between the Mórsárdalur rocks and liparitic rocks from elsewhere in Iceland. On the whole the chemical composition and the petrography of the liparites are the same in the Tertiary, the Pleistocene, and the post-Glacial periods, a fact which indicates that the conditions for their formation have been practically the same the whole time. Further the regional distribution of the liparites in Iceland appears to be accidental and does not point to any system in the occurrence of these rocks either, which seems to show that conditions for the formation of liparites existed and exists all over the country. The most likely explanation of this is to assume that they are—through transfusion—regenerated sialic material from a subbasaltic substratum, a view also held by RITTMANN and recently by VAN BEMMELEN and RUTTEN (1955 p. 185).

Table 1

	1.	2.	3.	4.
SiO_2	71.60	74.88	75.01	73.44
TiO_2	0.29	0.14	0.33	0.31
Al_2O_3	12.55	12.96	12.27	11.82
Fe_2O_3	1.89	0.77	0.80	1.97
FoO	2.74	1.05	2.78	1.56
MnO	0.10	tr	0.06	0.09
MgO	0.00	0.14	0.08	0.01
CaO	1.57	1.03	1.87	1.74
Na_2O	4.24	4.62	3.36	4.70
K_2O	3.00	3.54	2.80	3.68
P_2O_5	0.03	nil	0.02	0.44
H_2O^+	0.31	0.55	0.25	0.63
H_2O^-	1.33	0.34	0.13	0.14
CO_2	—	nil	—	—
S	—	0.11	0.02	—
	99.65	100.13	99.98[1])	100.53[2])

1. Grey liparite (rhyodacite) from lower dyke, Rauðhellar, Mórsárdalur. ME MOURITZEN anal.
2. Liparite, Pálsfjall in Vatnajökull. W. H. HERDSMANN anal. (A. NOE-NYGAARD, 1952).
3. Obsidian, Hrafntinnuhryggur near Krafla. I. B. FERGUSON anal. (F. E. WRIGHT, 1915).
4. Hypersthene hyalo-andesite (rhyolite), south flank of Litla Krafla. A. C. W. C. Bot anal. (R. W. VAN BEMMELEN og R. W. RUTTEN, 1955 (p. 182)).

DANSK RESUMÉ

I det dalstrøg — Morsárdalur — som i nordlig retning skærer sig ind lige øst for Skeiðarárjökull på Vatnajökulls østside på Island findes talrige rullesten af liparit, samt nu og da af obsidian. Der er lykkedes forf. i Rauðhellarfjeldet at finde repræsentanter for disse bjergarter faststående i form af gange. Der er udført en kemisk analyse af een af bjergarterne samt gennemført en optisk bestemmelse af de vigtigste mineralkomponenter; det viser sig herigennem, at der er en betydelig lighed mellem de fundne bjergarter i Morsárdalur og lipariterne fra andre egne af Island.

LITERATURE

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[1]) Including SO_3 0.07 and Cl 0.13.
[2]) Stated by authors to 100.41.

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