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ON THE PETROCHEMISTRY OF THE INFRACRUSTAL ROCKS IN THE SVECOFENNIDIC TERRITORY OF SOUTHWESTERN FINLAND

BY

AHTI SIMONEN

WITH 7 TABLES AND 5 FIGURES

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ABSTRACT

The petrochemistry of the infracrustal rocks in the Svecofennidic territory of Southwestern Finland is discussed on the basis of chemical analyses. The average chemical compositions of different rock groups and variation diagrams are presented. Some conclusions concerning the genetical problems of the rocks are discussed.

CONTENTS

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INTRODUCTION

According to the current ideas regarding Southwestern Finland we have here the roots of only a single mountain chain, the Svecofennidic including the Svionian and Bothnian formations (Sederholm 1932). The Finnish part of the Svecofennides is represented by metamorphic rocks of different origin and by various intrusions.

The infracrustal rocks in the Pre-Cambrian rock crust are nowadays classified from the magmatectonical point of view (Wahl 1936) into synkinematic, late-kinematic, and postkinematic intrusions. In the Svecofennidic orogeny the synkinematic intrusions are represented by many different rock types. Most noteworthy are granodiorites and granites with a gneissose texture associated with basic differentiates. In the Svecofennidic territory of Southwestern Finland there occur also rocks of the trondhjemitic suite as a beautiful differentiation series (Hietanen 1943). Furthermore, among the synkinematic intrusions there are observed the charnockitic rocks (Parras 1941; Hausen 1944; Metzger 1945). The late-kinematic infracrustal rocks are represented by the migmatite-forming microcline granites of the coast type. Furthermore there occur in the Svecofennidic territory of Southwestern Finland in limited areas microcline granites penetrating the late-kinematic intrusions. Apparently these granites (Onas, Åva, Bodom etc.) are the postkinematic intrusions of the Svecofennidic orogeny.

The method used here is based on the available analyses. A similar method has recently been used in Fennoscandia by Backlund (1937) and Magnusson (1938) in the discussion of petrological problems. In Finland Sederholm (1925) has earlier calculated the average composition of the earth's crust from the analyses and the geological maps, and Eskola (1927) has discussed the petrographical character of the Finnish rocks, basing himself in many points on petrochemical data. The latter investigation has been valuable to the present discussion and many Niggli numbers have been taken from it. Furthermore tables of analyses by Hackman (1905) and by Lokka (1934) have greatly helped the work of the present author.[1]

SYNKINEMATIC INTRUSIONS

The synkinematic intrusions of the granodioritic and granitic differentiation branch are petrochemically best known among the infracrustal

[1] After this paper was ready in manuscript form Niggli (1946) published an interesting discussion based on the petrochemical studies in Southern Finland, presenting ideas on the origin of granites and migmatites.

rocks of Southwestern Finland. The Niggli numbers are presented in Table I. The enclosed variation diagrams (Figs. 2—5) show that the synkinematic intrusions of the granodioritic branch belong almost without exception to a continuous differentiation series. The deviations from the differentiation curve are in general very small and the points in the *al*- and *fm*-diagrams are located in the urgranite field of Central Sweden, as determined by Magnusson (1938 pp. 296—299). In the *c*-diagram the synkinematic granodiorites and granites often show higher numbers than the urgranites, and in the *alk*-diagram again lower numbers. The synkinematic granodiorites and granites of Southwestern Finland are apparently more calcic than the urgranites of Central-Sweden.

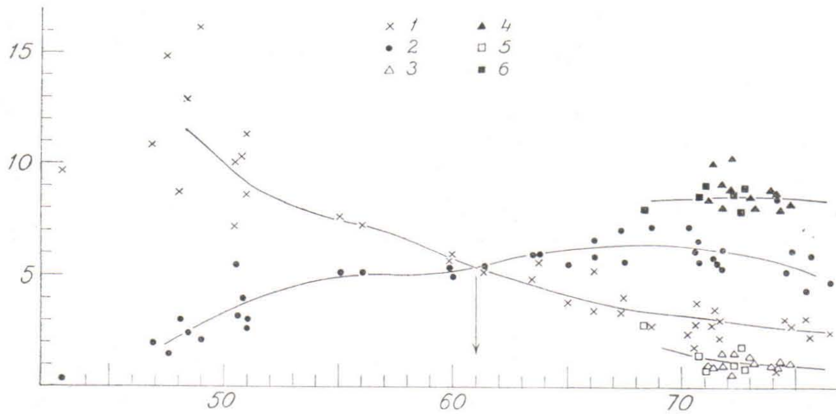

Fig. 1. Calc-alkali diagram of the Svecofennidic intrusions in Southwestern Finland. Abscissa = percentage SiO_2; ordinate = percentage CaO or alternatively $Na_2O + K_2O$. 1 = CaO and 2 = $Na_2O + K_2O$ for the synkinematic intrusions with the granodioritic differentiation branch. 3 = CaO and 4 = $Na_2O + K_2O$ for the late-kinematic intrusions. 5 = CaO and 6 = $Na_2O + K_2O$ for the postkinematic intrusions.

The synkinematic intrusions of Southwestern Finland of the granodioritic and granitic branch belong to a calcic magma type. The calc-alkali index is 61 (Fig. 1), this being very close to that of the trondhjemitic rocks of Kalanti (62 according to Hietanen).

In Niggli's (1923) magma type classification 34 is ore peridotitic and 77 represents a hornblendite-peridotitic type. 101—121 belong to the gabbroidic magmas having a normal-gabbroidic or hornblendite-gabbroidic character. 133 is related to an ossipite-gabbroidic type. 125—156 represent a normal-dioritic type. Among these 153 is characterized by a high *k*-number showing a magneritic character. 190—226 are quartz-dioritic. 241—289 represent granitic magmas of the granodioritic magma type. The more acid rocks ($si > 300$) belong to the yosemitic, normal-granitic and plagioclase-granitic magma types. 431 represents an engadinitic magma with an extremely high content of K_2O.

Table I. Synkinematic intrusions of the Svecofennidic orogeny with a granodioritic and granitic differentiation branch.

si	al	m	c	alk		mg	c/fm
34	0.5	98	1	0.5	0.13	0.39	0.01
77	8.5	72.5	18.5	0.5	0.20	0.72	0.26
101	19.9	43.2	34.0	2.9	0.13	0.63	0.79
103	20.4	39.1	36.7	3.8	0.24	0.75	0.95
105	22.7	47.0	26.3	4.0	0.17	0.36	0.56
114	20.5	52.5	20.5	6	0.08	0.64	0.39
114	22	45.5	27.5	5	0.13	0.64	0.60
115	25	47	22	6	0.26	0.53	0.47
116	25.6	36.4	33.1	4.9	0.29	0.45	0.91
121	23	44.5	26	6.5	0.22	0.64	0.58
125	30	28	30	12	0.08	0.45	1.07
133	32.1	30.1	28.9	8.9	0.28	0.36	0.96
134	30.7	36.7	20.3	12.3	0.29	0.38	0.55
153	26.8	38.9	22.7	11.6	0.39	0.52	0.58
156	29	36	22	13	0.24	0.39	0.61
190	31.1	35.2	20.3	13.4	0.30	0.44	0.58
193	26.7	38.3	19.7	15.3	0.25	0.32	0.51
205	32.6	33.0	18.7	15.7	0.27	0.41	0.57
226	33.1	28.1	21.4	17.4	0.36	0.51	0.76
241	36	25.5	20	18.5	0.41	0.55	0.78
255	37	29	14	20	0.48	0.43	0.48
256	34	25.5	21.5	19	0.33	0.41	0.84
261	35.8	29.4	16.6	18.2	0.37	0.17	0.56
262	34.5	26.4	21.6	17.6	0.25	0.43	0.82
281	35.9	26.5	18	19.6	0.28	0.40	0.68
289	38.3	21.3	15.6	24.8	0.34	0.39	0.73
314	38.9	19.7	14.1	27.3	0.37	0.26	0.72
325	41.5	18	12	28.5	0.50	0.45	0.67
328	38.2	21.7	14.4	25.7	0.33	0.37	0.66
335	40.5	17.1	19.6	22.8	0.27	0.40	1.15
343	37.5	23.5	15.5	23.5	0.29	0.27	0.66
356	40.2	20.3	16.1	23.4	0.58	0.27	0.80
425	42	12	19	27	0.14	0.23	1.59
428	41	18	14	27	0.38	0.26	0.78
430	41.7	16.5	19.0	22.8	0.13	0.36	1.15
431	43.8	13.4	4.6	38.2	0.50	0.19	0.34

34. Ilmenite-magnetite olivinite. Susimäki. Vampula. Palmunen (1925 p. 16).
77. Peridotite. Pyhälampi. Suomusjärvi. Eskola (1914 p. 90).
101. Olivine gabbro. Tunnholm. Borgå. Sederholm (1923 p. 43).
103. Gabbro. Tunnholm. Borgå. Sederholm (1923 p. 49).
105. Gabbro. W. of Myllyharju. Lavia. Mäkinen (1915 p. 418).
114. Amphibolite, intrusive, cummingtonite-bearing. N. of Lake Orijärvi. Kisko. Eskola (1914 p. 109).
114. Gabbro. Arvola. Hyvinkää. Hackman (1905 p. 62).
115. Gabbro. Stadslandet. Pernå. Sederholm (1923 p. 148).
116. Gabbro. N. of Naarajärvi. Lavia. Mäkinen (1915 p. 418).
121. Hornblende gabbro. Sepänlampi. Kisko. Eskola (1914 p. 71).
125. Hornblende-ilmenite gabbro. Susimäki. Vampula. Palmunen (1925 p. 11).
133. Hornblende gabbro. Mäkijärvi. Kisko. Eskola (1914 p. 87).
134. Gabbro diorite. Lavia. Mäkinen (1915 p. 419).
153. Quartz diorite. Tvärminne. E. of Hangö. Sederholm (1912 p. 304).
156. Diorite. Lavia. Mäkinen (1915 p. 419).

190. Quartz diorite. N. of Naarajärvi. Lavia. Mäkinen (1915 p. 418).
193. Quartz diorite. Tömäjärvi. Hämeenlinna area. Unpublished.
205. Quartz diorite. N. of Naarajärvi. Lavia. Mäkinen (1915 p. 418).
226. Quartz diorite. NW. of Naarajärvi. Lavia. Mäkinen (1915 p. 418).
241. Quartz diorite. Sassi. Hackman (1905 p. 50).
255. Granodiorite. W. of Välimäki. Lavia. Mäkinen (1915 p. 418).
256. Hornblende granite. Söderskatan. Sundarö. Pernå. Sederholm (1923 p. 118).
261. Gneissose granodiorite. Inderskärs Westgrund. Kumlinge. Åland. Lokka (1934 p. 28).
262. Diorite. Pöytyä. Hietanen (1947).
281. Granodiorite. Myllymäki. Hämeenlinna. Unpublished.
289. Gneissose granite. Våtskär. Pernå. Sederholm (1923 p. 139).
314. Gneissose granodiorite. S. of railway station in Parola. Hämeenlinna area. Unpublished.
325. Granite. Wester Rysskär. Pernå. Sederholm (1923 p. 117).
328. Gneissose granodiorite. Pappila. Vanaja. Hämeenlinna area. Unpublished.
335. Gneissose granite. Påvskär. Ingå. Sederholm (1926 p. 16).
343. Oligoclase granite. W. of Lake Orijärvi. Kisko. Eskola (1914 p. 41).
356. Gneissose granite. Ändö. Ingå. Sederholm (1926 p. 16).
425. Gneissose granite. Bockholm. Kumlinge. Åland. Sederholm (1934 p. 34).
428. Granite. Öster Rysskär. Pernå. Sederholm (1923 p. 116).
430. Gneissose granite. Bockholm. Kumlinge. Åland. Sederholm (1934 p. 34).
431. Gneissose granite. Skeppsvik. Eckerö. Åland. Sederholm (1934 p. 21).

Table II. Average chemical compositions of the Svecofennidic synkinematic gabbros, diorites, and granodiorites + granites compared with the averages calculated by Daly.

			2		3	4		5	6
SiO_2	[1])10	49.23	48.24	7	58.11	56.77	17	69.75	70.18
TiO_2	10	1.13	0.97	7	0.96	0.84	17	0.52	0.39
Al_2O_3	10	17.42	17.88	7	16.65	16.67	17	14.26	14.47
Fe_2O_3	10	1.86	3.16	7	1.74	3.16	17	0.91	1.57
FeO	10	7.62	5.95	7	6.31	4.40	17	2.82	1.78
MnO	8	0.21	0.13	4	0.26	0.13	15	0.07	0.12
MgO	10	6.69	7.51	7	3.28	4.17	17	1.16	0.88
CaO	10	11.48	10.99	7	6.35	6.74	17	3.36	1.99
Na_2O	10	2.16	2.55	7	3.28	3.39	17	3.37	3.48
K_2O	10	0.72	0.89	7	2.12	2.12	17	2.80	4.11
P_2O_5	5	0.40	0.28	5	0.32	0.25	13	0.25	0.19
H_2O	9	1.27	1.45	7	0.86	1.36	17	0.75	0.84
		100.19			100.24			100.02	

1. Average composition of gabbros in Southwestern Finland. Calculated from analyses 101—133 in Table I.
2. Average composition of gabbro according to Daly.
3. Average composition of diorites in Southwestern Finland. Calculated from analyses 134—226 in Table I.

[1] The numbers of this column show how many determinations have been available for calculation.

4. Average composition of diorites according to Daly.
5. Average composition of granodiorites + granites in Southwestern Finland. Calculated from analyses 241—431 in Table I.
6. Average composition of granites according to Daly.

In Table II are presented the average compositions of the synkinematic intrusions having gabbroidic, dioritic and granodioritic (including also granitic) bulk compositions. These averages are very similar to those presented by Daly (1933).

Among the rocks of the granodioritic and granitic branch of the synkinematic intrusions the acid differentiation products are predominant. According to the planimetric determinations in the map sheet of Tampere only 0.9 % of the oldest infracrustal rocks are basic intrusions (gabbros and diorites) while the acid intrusions (granodiorites and granites) constitute 99.1 %. In the Orijärvi area, on the other hand, the distribution of the synkinematic intrusions is as follows:

Oligoclase granites	44.8 %
Granodiorites + quartzdiorites	18.3 %
Diorites and gabbros	33.6 %
Peridotites	3.3 %

The trondhjemitic branch of the synkinematic intrusions is described by Hietanen (1943 pp. 42—45) who gives many analyses. In this connection the present author will not give values of the Niggli numbers, because these are easily seen in Hietanen's table of analyses. The trondhjemitic rocks form a beautiful differentiation series, as is seen in the variation diagrams Figs. 2—5.

Among the trondhjemitic rocks also the acid differentiation members are predominant. According to the planimetric determinations for the Kalanti area of the geological map (Hietanen 1943), the relative distribution of the trondhjemitic rocks is as follows:

»Tropfenquartz» trondhjemite	11.2 %
Trondhjemite	49.5 %
Diorite trondhjemite	29.1 %
Diorite	7.9 %
Gabbro	2.3 %

Using the analyses published by Hietanen and the distribution of the different rock types, the present author has calculated the average bulk composition of the trondhjemitic rocks in the Kalanti area (Table III).

Table III. Average bulk composition of the trondhjemitic magma province in the Kalanti area.

SiO_2	68.55
TiO_2	0.43
Al_2O_3	15.58
Fe_2O_3	0.63
FeO	2.68
MnO	0.05
MgO	1.49
CaO	3.36
Na_2O	4.48
K_2O	1.78
P_2O_5	0.10
H_2O	0.87

The relation between the differentiation curves for the granodioritic and granitic and the trondhjemitic branches is very remarkable, as the enclosed Niggli diagrams (Figs. 2—5) show that both differentiation curves intersect in the neighbourhood of *si*-number = 200. This fact is clearly seen in the *al-*, *fm-* and *alk*-diagrams. In the *c*-diagram, on the other hand, both differentiation curves are of a very similar character.

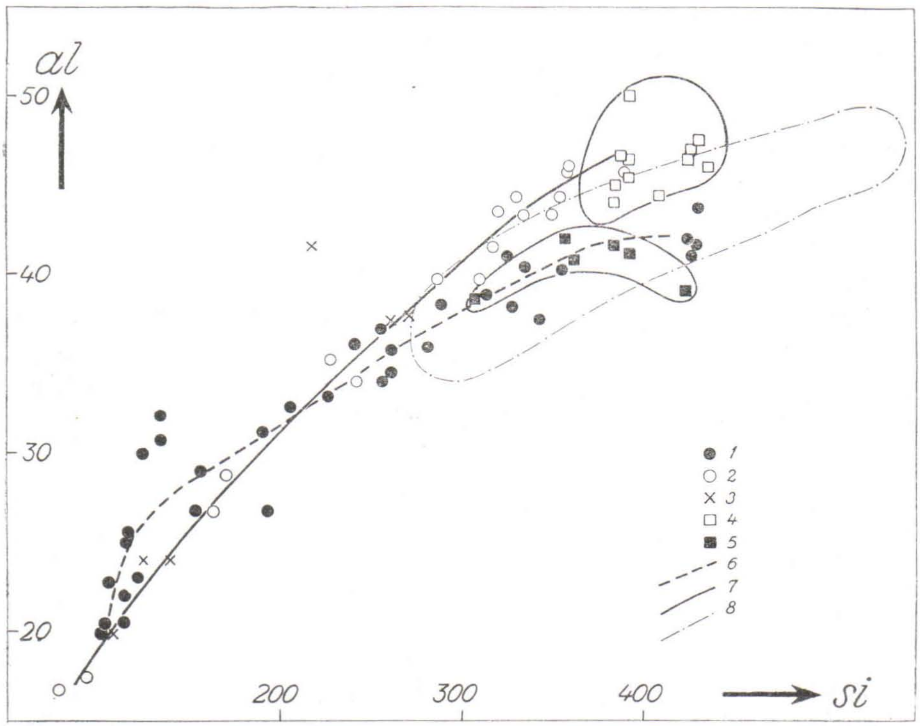

Fig. 2. The *al*-diagram of the infracrustal rocks in Southwestern Finland. 1 = synkinematic intrusions (gabbro-diorite-granodiorite-granite), 2 = trondhjemitic rocks, 3 = charnockitic rocks, 4 = late-kinematic intrusions and 5 = postkinematic intrusions. 6 = differentiation curve for the granodioritic and granitic branch of the synkinematic intrusions. 7 = differentiation curve for the trondhjemitic rocks according to Hietanen (1943). 8 = field of the urgranites in Central-Sweden according to Magnusson (1938).

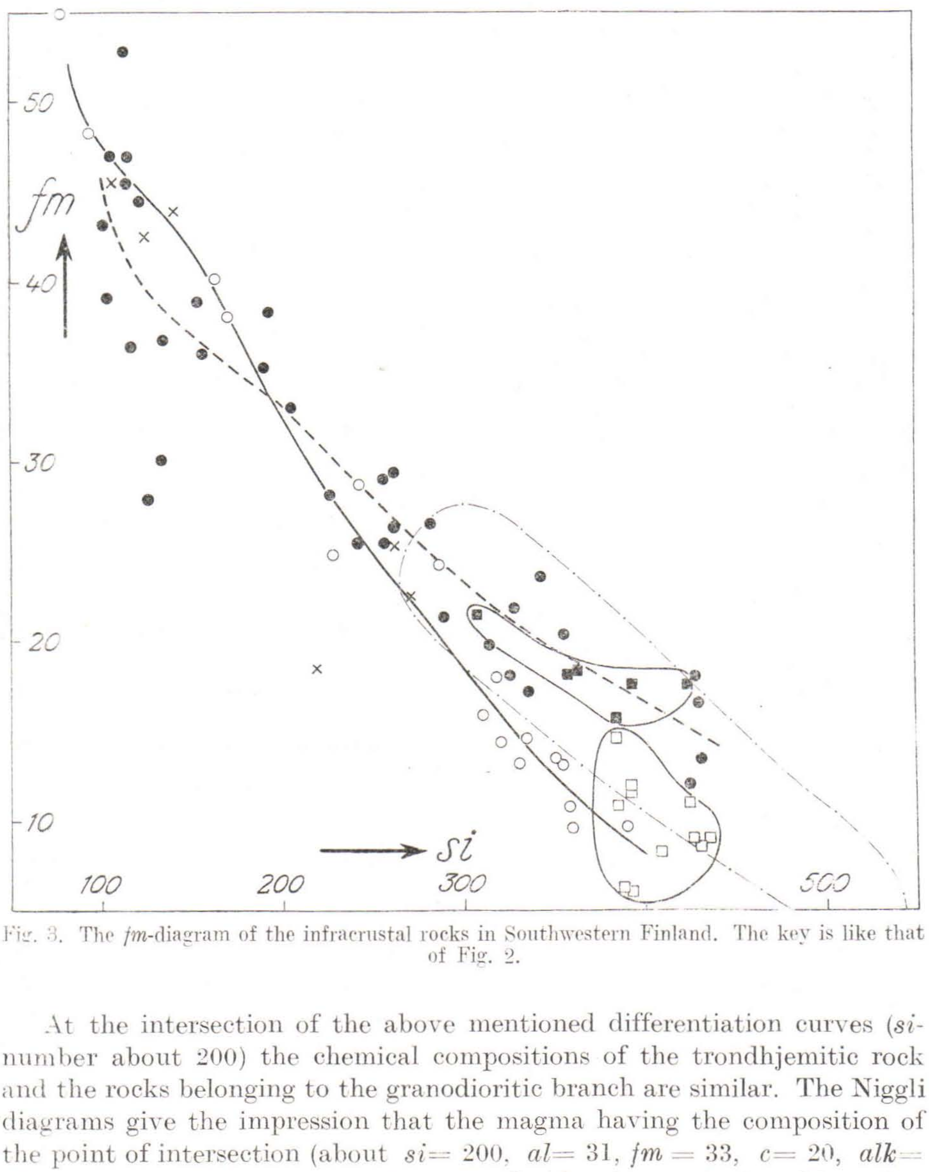

Fig. 3. The *fm*-diagram of the infracrustal rocks in Southwestern Finland. The key is like that of Fig. 2.

At the intersection of the above mentioned differentiation curves (*si*-number about 200) the chemical compositions of the trondhjemitic rock and the rocks belonging to the granodioritic branch are similar. The Niggli diagrams give the impression that the magma having the composition of the point of intersection (about $si = 200$, $al = 31$, $fm = 33$, $c = 20$, $alk = 16$) represents a common parent magma for the above mentioned branches of the Svecofennidic, synkinematic intrusions. The different paths of differentiation are caused only by the different amounts of the volatile substances in the magma. If the parent magma has been very rich in water, the differentiated rocks are trondhjemitic, but if not, granodiorites and granites have been formed. The high content of volatile substances in the parent magma may have increased through secondary processes. The Finnish trondhjemites, for instance, occur in an area very rich in

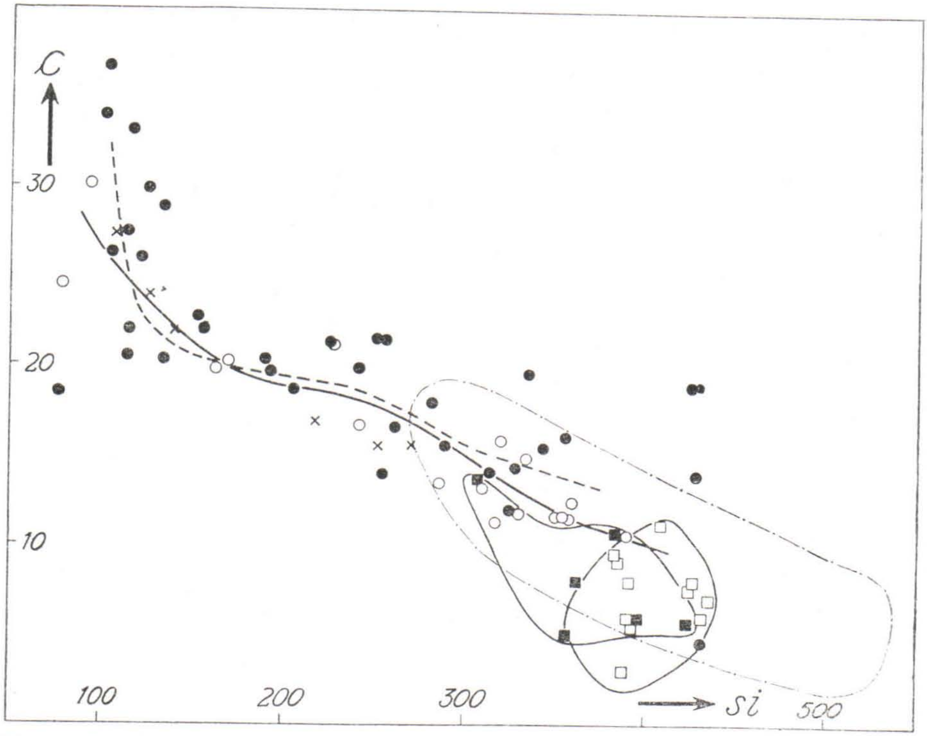

Fig. 4. The c-diagram of the infracrustal rocks in Southwestern Finland. The key is like that of Fig. 2.

kinzigites which originally have been clayey sediments. It seems probable that the parent magma of the trondhjemites has received its high water content from these original clays.

The charnockitic rocks of Southwestern Finland are petrochemically not well known and the opinions put forward as to their origin lack a reliable basis. Hackman (1923) was the first to describe the charnockitic pyroxene granodiorite of Southwestern Finland. According to Hackman the pyroxene granodiorite belongs genetically to the microcline granites of the coast type (to the late-kinematic intrusions according to the new terminology). Later studies (Hausen 1944; Metzger 1945) show, however, that the charnockites belong to the synkinematic intrusions of the Svecofennides. Parras (1941) has also described some pyroxene-bearing rocks which belong to the charnockites. The chemical character of the charnockites is not well known, only two complete analyses having been published (Hackman 1923 p. 3; Metzger 1945 p. 59). Other analyses presented by Metzger are old or calculated from geometrical analyses.

Recently Anna Hietanen has carried out petrological studies on the charnockites in the Turku area of Southwestern Finland. The manuscript of Hietanen's investigation has been at my disposal and some chemical analyses have been taken from it.

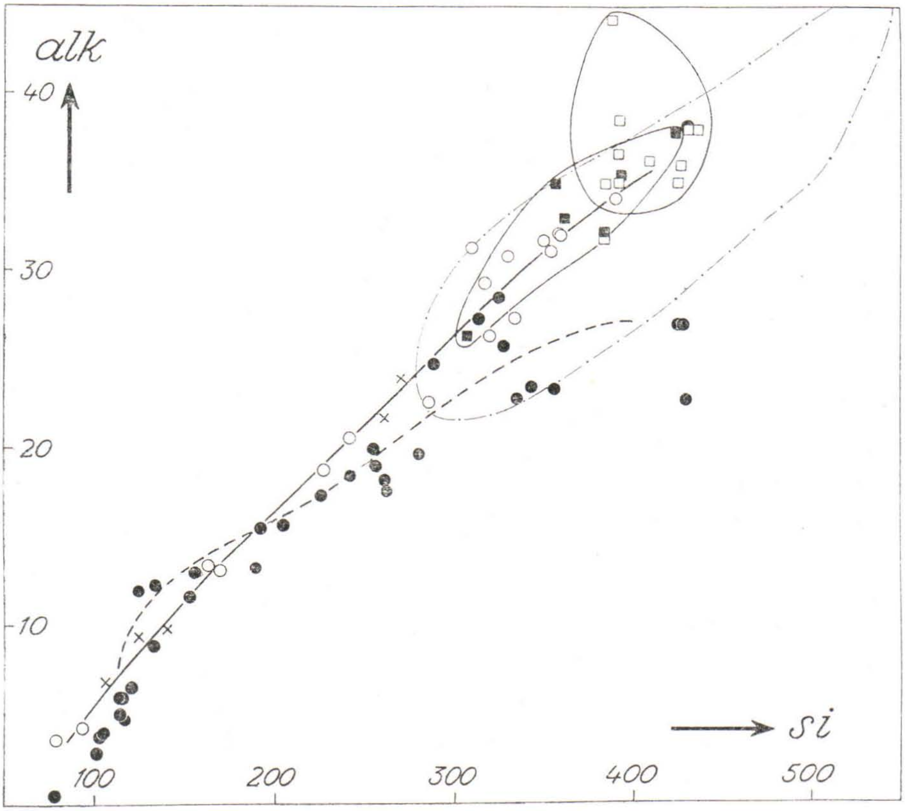

Fig. 5. The *alk*-diagram of the infracrustal rocks in Southwestern Finland. The key is like that o Fig. 2.

Table IV. Charnockitic rocks of the Svecofennidic orogeny.

si	al	fm	c	alk	k	mg	c/fm
107	20	45.5	27.5	7	0.11	0.65	0.61
125	24	42.5	24	9.5	0.14	0.58	0.56
140	24	44	22	10	0.09	0.48	0.50
218	41.5	18.5	17	23	0.28	0.42	0.92
261	37.2	25.3	15.7	21.8	0.13	0.49	0.62
270	37.8	22.4	15.8	24.0	0.20	0.48	0.71

107. Norite. Turku area. Hietanen (1947).
125. Norite. Turku area. Hietanen (1947).
140. Pyroxene diorite. Kalkholmen. Metzger (1945 p. 59).
218. Pyroxene granodiorite. Kakskerta. Hackman (1923 p. 3).
261. Trondhjemitic charnockite. Turku area. Hietanen (1947).
270. Charnockite. Turku area. Hietanen (1947).

In Table IV are presented the Niggli numbers of analysed charnockitic rocks. In variation diagrams (Figs. 2—5) the points representing charnockites are situated near to the differentiation curve of trondhjemites. The chemical composition of the charnockitic and trondhjemitic rocks is very similar and differences appear only in the mineralogical composition.

According to Hietanen the trondhjemitic and charnockitic rocks in the Turku area are closely related and they have differentiated from the same parent magma. Apparently all different kinds of synkinematic intrusions in Southwestern Finland have developed from the common parent magma, in which only the different content of volatiles has caused different paths of differentiation-crystallization. In magmas rich in volatiles the crystallization gives trondhjemitic rocks and from dry magmas charnockites crystallize. Between these extreme series occur synkinematic intrusions of granodioritic and granitic differentiation branch.

LATE-KINEMATIC INTRUSIONS

The late-kinematic intrusions of the Svecofennidic orogeny in Southwestern Finland are represented, as far as known, by the acid microcline granites. These granites are commonly migmatite-forming, but also more homogeneous types are met with. The calc-alkali diagram (Fig. 1) shows that the late-kinematic intrusions are more alkalic than the synkinematic intrusions. In Table V are given the Niggli numbers of the late-kinematic intrusions. They show that the chemical composition does not vary greatly.

Table V. Late-kinematic granites of the Svecofennidic orogeny.

s	al	fm	c	alk	k	mg	c/fm
384	44.0	14.5	9.5	32.0	0.64	0.35	0.66
385	45.0	10.8	9.3	34.9	0.58	0.23	0.86
388	46.6	6.2	3.0	44.2	0.47	0.19	0.48
392	46.5	11.9	6.0	36.6	0.67	0.29	0.50
392	45.5	11.5	8.0	35.0	0.55	0.26	0.70
393	50.0	6.0	5.5	38.5	0.71	0.43	0.92
409	44.4	8.2	11.2	36.2	0.63	0.09	1.37
425	46.5	11.0	7.5	35.0	0.61	0.28	0.68
427	47.0	9.0	8.0	36.0	0.47	0.08	0.89
431	47.5	8.5	6.0	38.0	0.64	0.29	0.71
436	46.0	9.0	7.0	38.0	0.45	0.21	0.78

384. Granite. Skarvkyrkan. E. of Hangö. Sederholm (1912 p. 304).
385. Microcline granite. Between Lakes Alajärvi and Hattelmalanjärvi. Hämeenlinna area. Unpublished.
388. Aplitic granite. Western shore of Lake Katumajärvi. Hämeenlinna area. Unpublished.
392. Granite. Mattnäs. Nagu. Hausen (1944 p. 62).
392. Granite. Lörpys. Kuru. Hackman (1905 p. 31).

393. Microcline granite. Pajback. Parainen. Metzger (1945 p. 66).
409. Granite. Lauttasaari. Huopalahti. Rankama (1941 p. 6).
425. Granite. Drottningsberg. Hangö. Hackman (1905 p. 30).
427. Granite. Kumlinge. Åland. Sederholm (1934 p. 30).
431. Microcline granite. Sillanpää. Kisko. Eskola (1914 p. 17).
436. Granite. Svenvik. Ingå. Sederholm (1926 p. 64).

The late-kinematic granites belong to engadinitic and aplitegranitic magma types in Niggli's classification. Their average chemical composition is presented in Table VII.

Characteristic of the late-kinematic microcline granites are the high values of the *al*- and *alk*-numbers and the low values of the *fm*- and *c*-numbers. This kind of composition is generally characteristic of the palingenic granites freed from the mafic components. The fields occupied by the late-kinematic intrusions in the enclosed Niggli diagrams (Figs. 2—5) do not show the elongated forms characteristic of those rock groups in which magmatic differentiation has taken place.

POSTKINEMATIC INTRUSIONS

In Southwestern Finland there occur many microcline granites penetrating the late-kinematic granites. According to Sederholm's classification these belong to the third group of Fennoscandian granites alongside with the late-kinematic granites of the Karelidic Zone. According to the magmatectonical classification of intrusions it seems, however, that these microcline granites, penetrating the migmatite-forming granites in Southwestern Finland, belong to the postkinematic intrusions of the Svecofennidic orogeny.

Table VI. Postkinematic granites of the Svecofennidic orogeny.

	a	fm	c	alk	k	mg	c/fm
307	38.6	21.4	13.7	26.3	0.63	0.23	0.64
357	42.0	18.0	5.0	35.0	0.52	0.22	0.28
362	40.8	18.2	8.0	33.0	0.57	0.43	0.44
384	41.6	15.6	10.7	32.1	0.51	0.32	0.69
393	41.1	17.5	6.0	35.4	0.56	0.19	0.34
423	39.0	17.5	5.7	37.8	0.63	0.00	0.33

307. Granite. Obbnäs. Kyrkslätt. Sederholm (1926 p. 92).
357. Granite. Onas. Hackman (1905 p. 37).
362. Granite. Nyhamn. Lemland. Åland. Sederholm (1934 p. 51).
384. Granite. Åva. Brändö. Åland. Sederholm (1924 p. 148).
393. Granite. Obbnäs. Kyrkslätt. Lokka (1934 p. 16).
423. Granite. Onas. Borgå. Borgström (1931 p. 3).

Petrochemically the postkinematic granites of Southwestern Finland are very homogeneous. Although only 6 analyses are available (Table VI), they apparently are microcline granites very similar to the late-kinematic granites but some differences may, however, be observed.

In Table VII the average chemical compositions of the late-kinematic and postkinematic granites are presented. Some important differences are shown, the most remarkable being the higher content of SiO_2, Al_2O_3 and K_2O and the lower content of the mafic components (TiO_2, Fe_2O_3, FeO, MgO and CaO) in the late-kinematic granites.

Table VII. Average compositions of late-kinematic and postkinematic granites in the Svecofennidic rock crust of Southwestern Finland.

	1		2	
SiO_2	11	72.96	6	71.50
TiO_2	11	0.22	6	0.47
Al_2O_3	11	14.19	6	13.34
Fe_2O_3	11	0.46	6	1.13
FeO	11	1.17	6	2.17
MnO	7	0.03	5	0.04
MgO	11	0.30	5	0.66
CaO	11	1.15	6	1.52
Na_2O	11	2.86	6	2.85
K_2O	11	6.02	6	5.69
P_2O_5	6	0.12	5	0.13
H_2O	11	0.55	6	0.67
		100.03		100.17

1. Average chemical composition of the late-kinematic granite in the Svecofennides of Southwestern Finland. Calculated from analyses 384—436 in Table V.
2. Average chemical composition of the postkinematic granites in the Svecofennides of Southwestern Finland. Calculated from analyses 307—423 in Table VI.

The differences between the late-kinematic and postkinematic intrusions are seen also in the Niggli diagrams (Figs. 2—5). Especially in the *al*- and *fm*-diagrams the postkinematic granites cover fields separate from those of the late-kinematic intrusions. Furthermore, the fields of the postkinematic intrusions in the variation diagrams are elongated in the direction of the magmatic differentiation. The forms of the fields in the variation diagrams suggest the idea that the postkinematic granites have crystallized through magmatic differentiation while, on the other hand, the late-kinematic granites have a palingenic mode of occurrence and they have originated through granitization.

The author desires to present his best thanks to his wife Laura, who has assisted in calculations of Niggli numbers and average compositions.

Geological Survey of Finland, 1947.

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