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SOME PETROCHEMICAL CHARACTERS OF SAMADAI GRANITIC COMPLEX, SOUTH EASTERN DESERT, EGYPT

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ABSTRACT

The Samadai granitic complex in the Central Eastern Desert of Egypt is petrochemically evaluated. Major oxides data of 13 new chemical analysis are advanced and processed following several chemical parameters. The serial characters, NIGGLI values and normative minerals are discussed. The rocks of the complex belong to the calc-alkaline series and are dominantly potassic with some sodic tendencies. Chemical classification of the granitic complex is presented.

INTRODUCTION

The granitic complex of Samadai is considered by EL-RAMLY and AKAAD [1960], SABET [1961] and EL-RAMLY [1972] as belonging to the younger group of granitoids. SABET *et al.,* [1976] grouped the granitic complex of Samadai with several granitic plutons in the Eastern Desert of Egypt as belonging to the Late-Proterozoic-Early Paleozoic intrusions. The same authors also [*op-cit.,* 1976] assigned these granitic plutons to the "Gattarian group" and to the phase of the coarse-grained biotite granite and the leucocratic granite.

The examined rocks of Samadai granitic complex occur along the Eastern border of the basement rocks in the Red Sea Coast, *(Fig. 1)*. The northern part of the complex has been previously examined by ESSAWY, [1967]. He mentioned some details of the field characters and petrography of the complex. According to ESSAWY *(op. cit.)* the complex consists essentially of medium-grained adamellites and granodiorites associated with tonalites and minor granites. However, ESSAWY *(op. cit.)* gave no details of the petrochemical characters or the chemical classification of Samadai granitic complex. Later, ESSAWY [1972] in an attempt to reveal the genetic relationships between members of the complex advanced the results of partial analysis for certain elements (Na, K, Rb, Sr) of the rock units of the complex. He concluded that the calc-alkaline granites bear no parental relation to the adamellite and granodiorites.

The present study forms part of a continuing investigation of the petrochemistry and petrogenesis of the younger granitoids of Precambrian age in the Eastern Desert of Egypt.

GEOLOGIC SETTING OF SAMADAI AREA

Samadai area is dominantly formed of Precambrian basement rocks. According to ESSAWY [1967] the basement rocks of the examined area comprise metasediments, serpentinites, metagabbro-diorite complex, granites, adamellites and granodiorites.

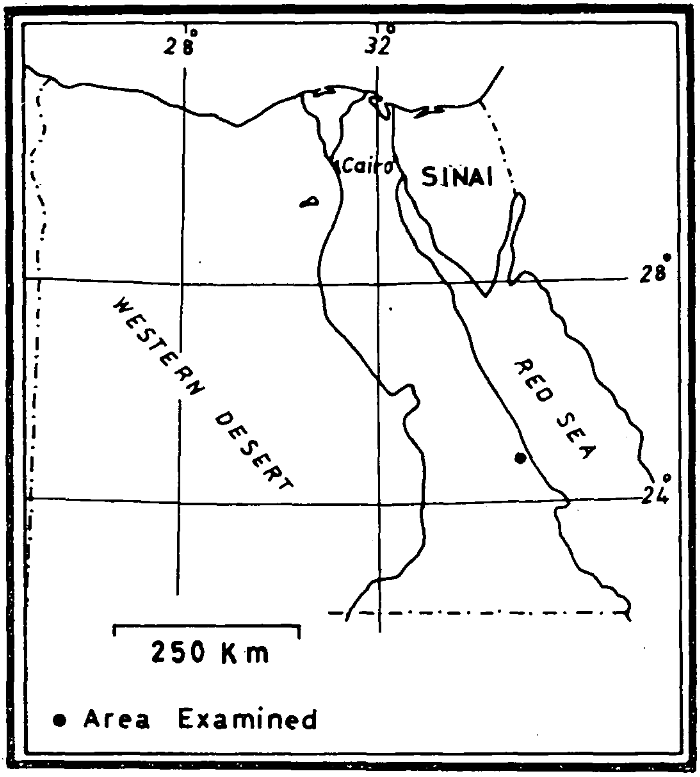


Fig. 1. Location map

The present work deals mainly with the granitic complex of Samadai which comprise two field types: pink — red granitic rocks and greyish-white granodiorites. The granitic rocks of Samadai form a rather circular body showing sharp intrusive contacts with older country rocks to the north, west and south and which comprise metasediments, Serpentinites and metagabbro-diorite rocks. The various basement rocks are traversed by few post-granite dykes *(Fig. 2)*. Based on field observations and crosscutting relations as well as the presence of xenoliths of the country rocks within the host granitic rocks, it is believed that the granitic complex is of younger age. Contacts between the various members of the granitic complex may be sharp but more commonly they are gradational. The granitic complex appears to have reached the present position probably as a result of forcible intrusion pushing aside and shouldering apart of the country rocks. According to Essawy [1967] the emplacement was reasonably accompanied by some kind of the granite tectonics resulting in thrusting, phyllonitisation of metasediments and brecciation of serpentines.

PETROGRAPHY

The detailed petrography of Samadai granitic complex has already been mentioned by Essawy *(op. cit.)*. Generally rocks of the complex are medium-to rather coarse-grained with holocrystalline hypidiomorphic granular texture. They are usually non-porphyritic and even-grained. Few types are porphyritic with quartz and plagioclase megacrysts. Intergrowths such as micrographic and myrmekitic are sometimes striking. Both biotite and hornblende represent the mafic minerals. Rarely biotite is the sole mafic. Secondary chlorite is not uncommon while apatite, zircon, epidote, sphene, magnetite and ilmenite are notable accessories.

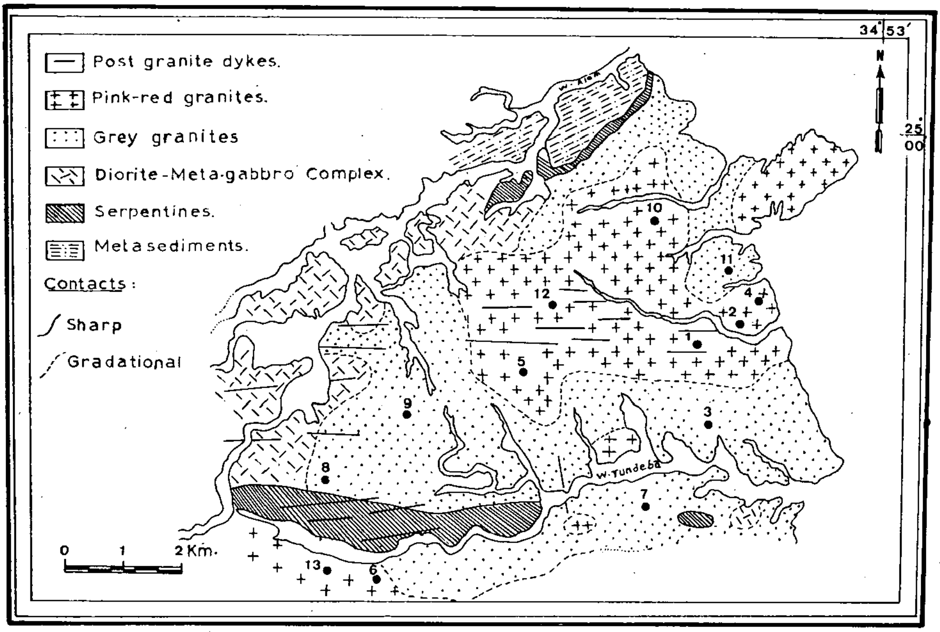


Fig. 2. Generalized geological map of Samadai area showing granitic types with samples location

PETROCHEMICAL INVESTIGATION

The petrochemical characters of the granitic rocks were clarified from RITTMAN's Suite Index, normative minerals, NIGGLI values and variation diagrams as calculated from the chemical data obtained.

Complete chemical analysis of 13 samples representing the different types of Samadai granitic complex were carried out and the results are given in Table 1 while the location of the analysed samples is shown in *Fig. 2*.

RITTMAN'S INDEX

RITTMAN's Suite indices, [1957] for Samadai granitic rocks are given in Table 1 and plotted graphically in *Fig. 3* against SiO_2. It is clear from the diagram and according to the quantitative subdivisions of RITTMAN that these granitic rocks range between weak pacific and strong pacific (2.24—4.53) which correspond on the average to calc-alkaline character.

The chemical composition of rocks in Table 1 has been recalculated in terms of K_2O+Na_2O, $FeO+Fe_2O_3$ and MgO and the results are plotted on an AFM diagram

TABLE 1

Chemical analyses of Samadai granitic rocks

	1	2	3	4	5	6	7	8	9	10	11	12	13
SiO_2	70.93	71.53	72.14	65.08	70.55	69.75	68.11	70.97	70.16	72.55	71.70	64.30	67.81
Al_2O_3	14.10	13.13	13.25	15.68	15.29	14.78	13.55	14.53	15.29	13.32	13.74	17.84	14.50
Fe_2O_3	2.27	1.85	0.24	4.33	0.52	1.18	3.56	0.74	1.52	0.67	0.82	2.88	2.20
FeO	1.19	1.45	2.35	1.06	1.24	1.29	2.30	0.76	1.63	1.27	1.31	3.42	1.79
MnO	—	—	0.01	—	—	—	0.03	—	—	—	—	0.02	—
MgO	0.43	0.54	0.42	0.50	1.74	1.71	0.27	0.58	0.29	0.50	0.50	0.95	0.89
CaO	0.66	0.60	0.91	2.73	0.42	0.49	0.88	0.49	0.49	1.02	0.49	1.20	0.66
Na_2O	4.25	3.88	4.81	4.50	4.00	4.13	4.00	5.00	4.38	4.75	3.94	4.25	4.63
K_2O	5.00	4.78	4.88	5.50	4.88	5.25	4.88	5.06	4.50	3.38	5.38	3.13	5.00
TiO_2	0.38	0.38	0.03	0.55	0.03	0.03	0.49	0.03	0.64	0.15	0.30	0.66	0.40
P_2O_5	0.31	0.31	—	—	—	—	—	0.24	—	—	—	0.24	0.24
H_2O	0.98	0.72	0.68	0.46	1.58	0.80	1.00	0.72	1.08	1.50	1.12	1.12	1.07
TOTAL	100.50	99.17	99.72	100.39	100.25	99.41	99.07	99.12	99.98	99.11	99.30	100.01	99.19
RITTMAN'S Index	3.06	2.63	3.22	4.53	2.86	3.31	3.14	3.61	2.89	2.24	3.02	2.56	3.73
Agp. Coef.	0.88	0.88	0.96	0.85	0.78	0.84	0.88	0.94	0.79	0.86	0.90	0.58	0.90

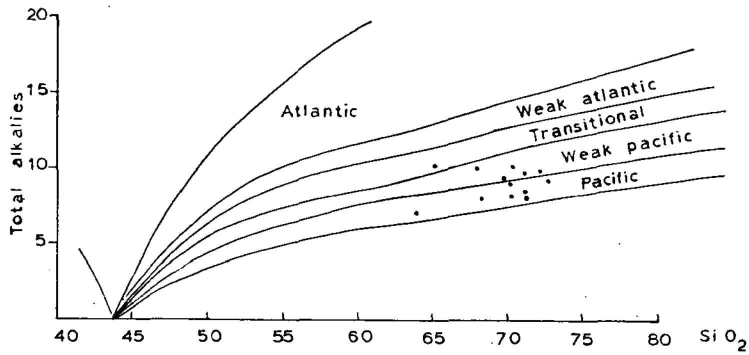


Fig. 3. SiO_2—(Na_2O+K_2O) diagram [after RITTMANN, 1957]

(Fig. 4). The diagram shows that the Samadai granitic rocks are enriched in alkalies and impoverished in magnesium and iron.

The analyses have been plotted on the ternary diagram K_2O — CaO — Na_2O *(*Fig. 5.*)* and follow a calc-alkaline trend [*cf.* NOCKOLDS and ALLEN, 1953].

Fig. 6 shows the relation between agpaitic coefficient and SiO_2 percent. The agpaitic coefficient from Zavaritski parameter [*cf.* BAILEY and MACDONALD, 1970] is plotted against SiO_2 to show the nature of Samadai granitic rocks. The diagram shows that all the examined rocks are of miaskitic nature i.e. mol. ratio of Na_2O+K_2O Al_2O_3 is less than unity.

The examined granitic rocks have K_2O/Na_2O ratio >0.6 *(Fig. 7)*. According to RAGUIN [1965] these granitic rocks have potassic character with very few showing sodic tendency.

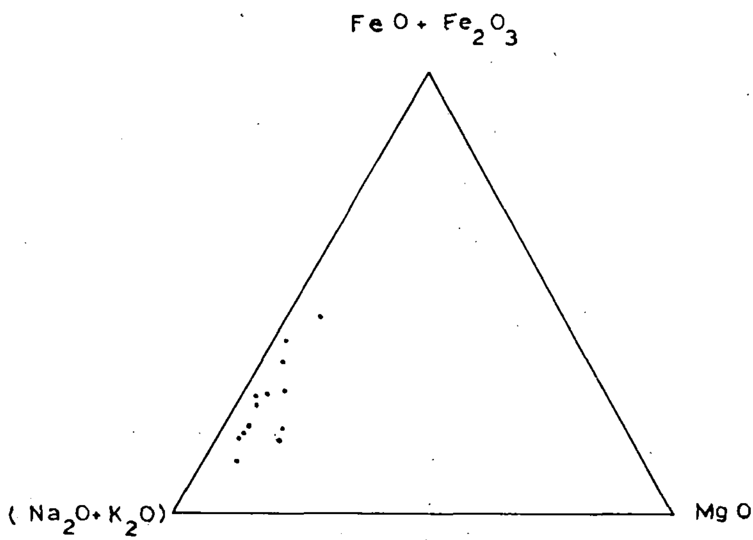


Fig. 4. Variation diagram showing the relationship between MgO—(Fe_2O_3+FeO)—(Na_2O+K_2O)

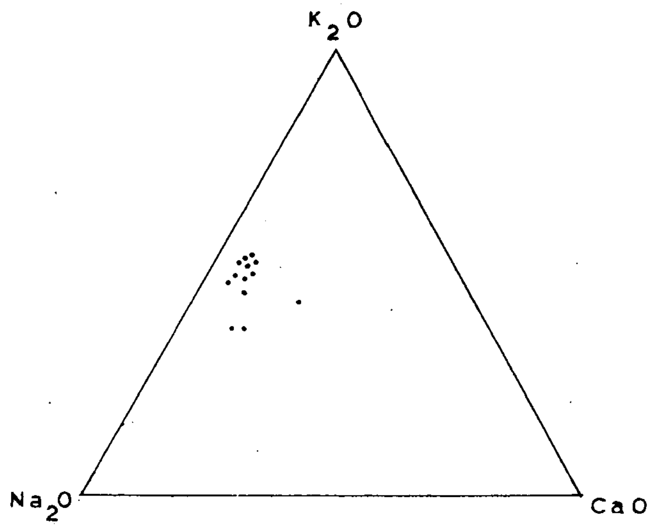


Fig. 5. K_2O—Na_2O—CaO diagram of the investigated granitic rocks

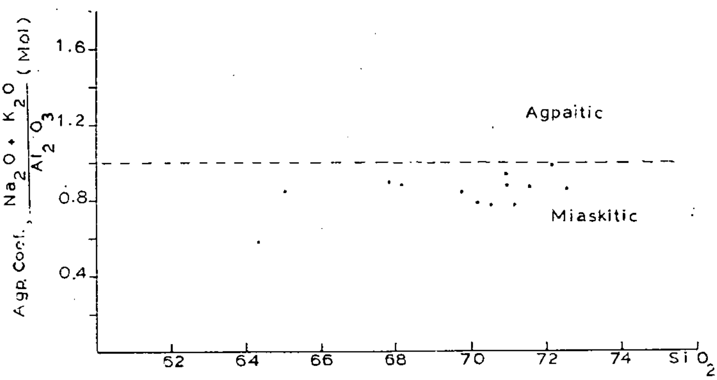


Fig. 6. Agpaitic index — silica diagram

The calculated NIGGLI values of the investigated granitic rocks are given in Table 2. The values of *al* are plotted against *fm* values of NIGGLI *(Fig. 8)* showing that the nature of the magma is salic according to NIGGLI's classification.

The values of *al* are plotted against *alk* of NIGGLI *(Fig 9.)*. It is clear that almost all the granitic rocks of Samadai fall within the relatively alkali-rich, with one sample representing granodiorites falling in the intermediate alkaline rocks [BURRI, 1964].

The NIGGLI values are plotted on the appropriate D-diagram of NIGGLI's series of *(al-alk)—fm—e* triangular diagram [1954] which includes the rock categories I and II (alkali-aluminous), III (alkali-calc-aluminous) VI (alkali-calc-femic) and VII (aluminous). It is evident from the diagram on *Fig. 10* that all the samples plot in the categories I and II.

The calculated norm values of the examined granitic rocks are given in Table 3. *Fig. 11* shows normative quartz plotted against normative anorthite. It is evident

TABLE 2

NIGGLI *values of the investigated granites*

	1	2	3	4	5	6	7	8	9	10	11	12	13
al	42.24	41.60	40.37	37.07	44.01	41.27	38.17	44.55	45.99	43.57	44.17	43.13	39.71
fm	17.00	18.33	14.38	19.62	19.64	21.40	23.90	10.70	15.00	12.83	13.41	26.50	20.92
c	3.60	3.46	5.04	11.73	2.20	2.49	4.51	2.73	2.68	2.07	2.86	5.27	3.30
alk	37.16	36.61	40.21	31.58	34.15	34.84	33.42	42.01	36.32	37.53	39.56	25.09	35.86
si	360.60	384.58	373.02	261.10	344.61	330.52	325.60	369.26	358.12	402.73	391.15	263.79	316.75
k	0.44	0.45	0.40	0.45	0.45	0.46	0.45	0.40	0.40	0.32	0.47	0.33	0.42
mg	0.19	0.24	0.23	0.15	0.64	0.56	0.07	0.42	0.15	0.32	0.30	0.22	0.30
qz	+111.96	+138.14	+112.20	+34.79	+108.02	+91.15	+91.92	+101.22	+112.84	+152.61	+132.91	+63.43	+73.31

TABLE 3

Norm-values for the examined granites

	1	2	3	4	5	6	7	8	9	10	11	12	13
gz	24.28	27.78	20.54	11.94	22.67	20.04	22.59	19.56	24.15	26.97	24.42	21.69	18.25
or	29.85	28.95	29.05	32.60	29.10	31.30	29.91	30.15	27.00	20.45	32.50	18.85	30.10
ab	38.60	35.75	43.55	40.55	36.25	37.47	37.15	45.30	39.90	43.70	36.15	38.85	42.35
an	1.20	1.00	0.15	6.40	2.10	2.45	4.50	0.85	2.45	5.20	2.50	4.45	1.75
c	1.40	1.37	—	—	2.92	1.56	0.11	0.57	2.58	—	0.60	6.51	0.94
w	—	—	1.76	2.88	—	—	—	—	—	—	—	—	—
en	1.20	1.52	1.18	1.38	4.84	4.76	0.72	1.62	0.82	1.42	1.42	2.68	2.50
fs	—	0.44	3.48	—	1.54	1.16	0.46	0.62	0.58	1.32	1.08	2.46	0.70
mt	1.86	1.98	0.25	1.32	0.54	1.24	3,85	0.78	1.62	0.72	0.87	3.06	2.34
il	0.54	0.54	0.04	0.76	0.04	0.04	0.70	0.04	0.90	0.22	0.42	0.94	0.56
ap	0.67	0.66	—	—	—	—	—	0.51	—	—	—	0.51	0.51
ht	0.40	—	—	2.15	—	—	—	—	—	—	—	—	—
Total	100	99.99	100	99.98	100	100	99.99	100	100	100	100	100	100

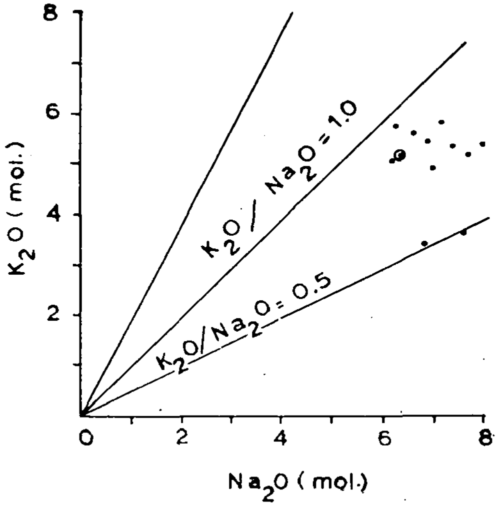


Fig. 7. Variations in alkalies of the granitic rocks ⊙ superimposed point

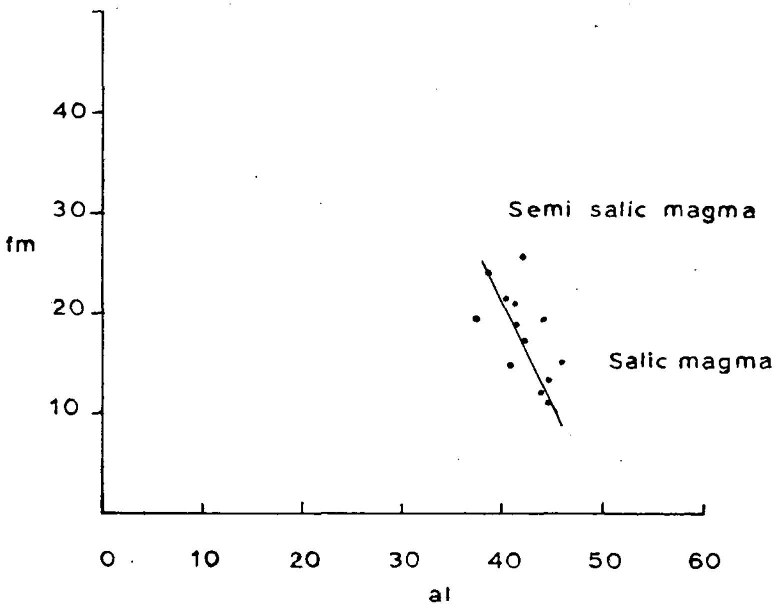


Fig. 8. al — fm diagram

from the diagram that nearly all the granitic rocks fall within the calc-alkalic series with only one sample plotting in the alkalic-calc series.

The normative Ab, Or and Qz are recalculated to 100% for Samadai granitic rocks and plotted on the ternary diagram (Ab—Or—Qz) the residua of TUTTLE and BOWEN [1958]. The plots *Fig. 12* show that the granitic rocks are rather enriched in albite. It is clear that all the analysed samples fall within the area of maximum con-

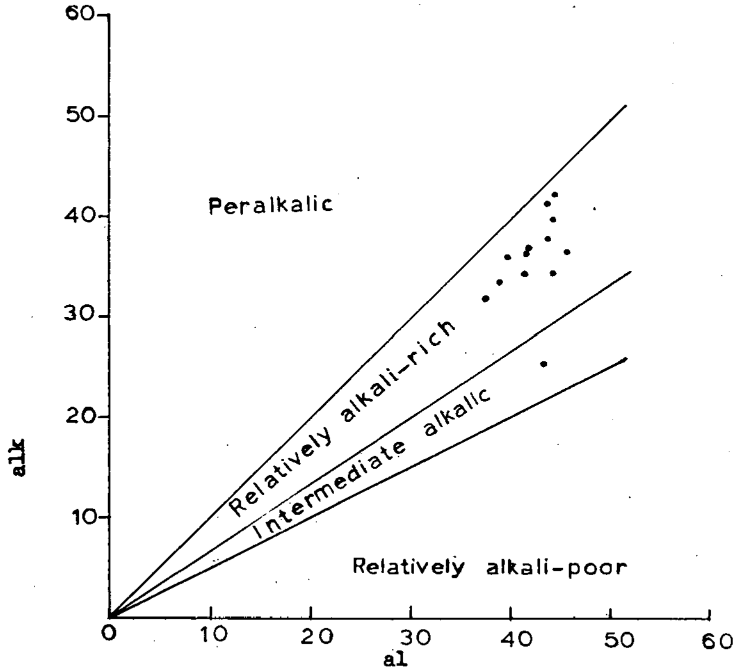


Fig. 9. Relationships of al and alk in the granitic rocks [after BURRI and NIGGLI, 1945]

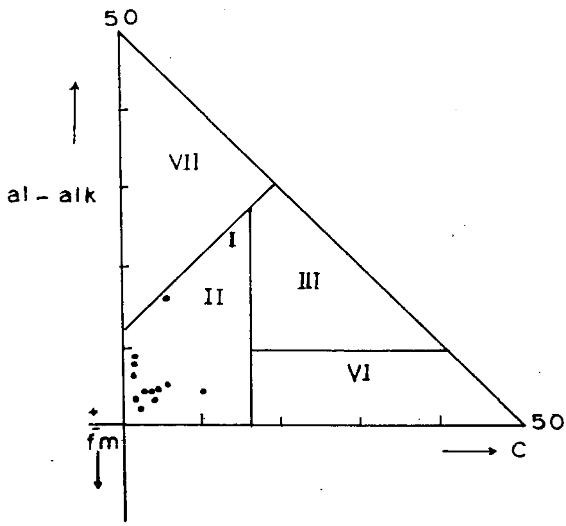


Fig. 10. Relationships of *al-alk* and *c* in the granitic rocks. NIGGLI's D-diagram
I—II: Alk-al silicate rocks
III: Alk-calc-al silicate rocks:
VI: Alk-calc-femic rocks
VII: Al-silicate rocks

centration of analyses of the granites of the world according to TUTTLE and BOWEN (*op. cit.* 79) "the concentration of the analyses near the centre of the diagram is readily explained if the magmatic history is involved in the origin of most granites". The granitic rocks of Samadai are thus considered to possess a magmatic history.

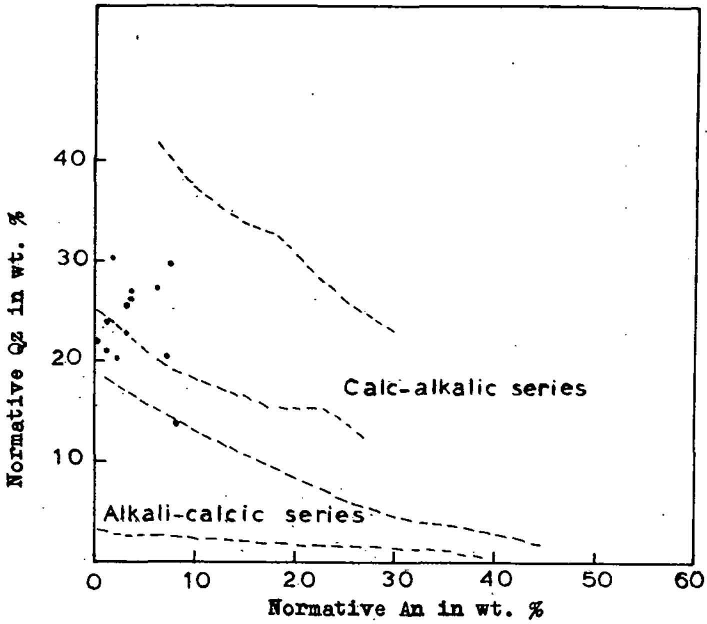


Fig. 11. Normative Qz — An relation for the investigated granites

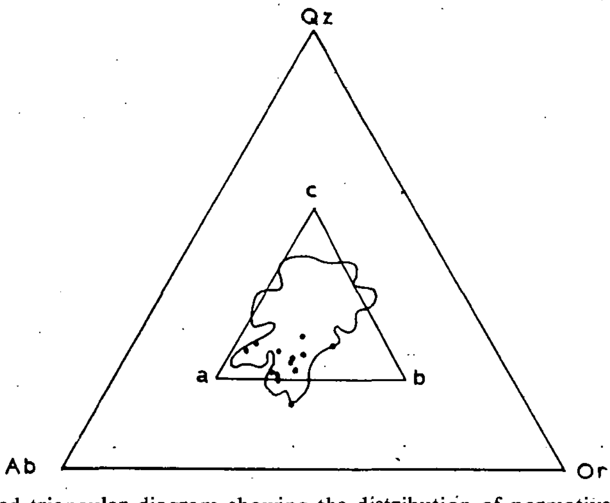


Fig. 12. Contoured triangular diagram showing the distribution of normative Ab — Or — Qz in all analysed rocks (1269) in WASHINGTON'S Tables, containing 80% or more Ab+Or+ +Qz [after TUTTLE and BOWEN, 1958 and MARMO, 1971]

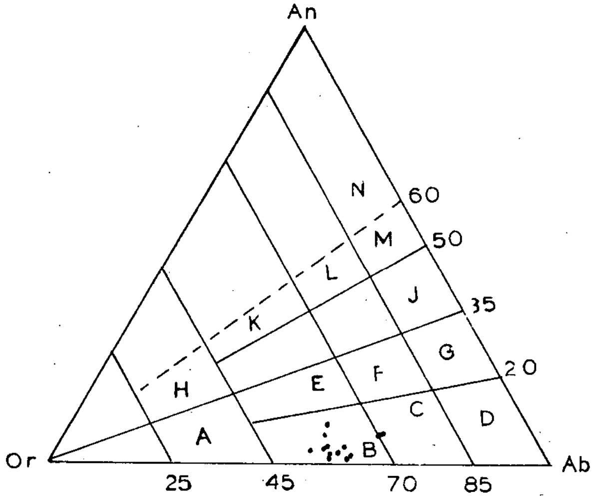
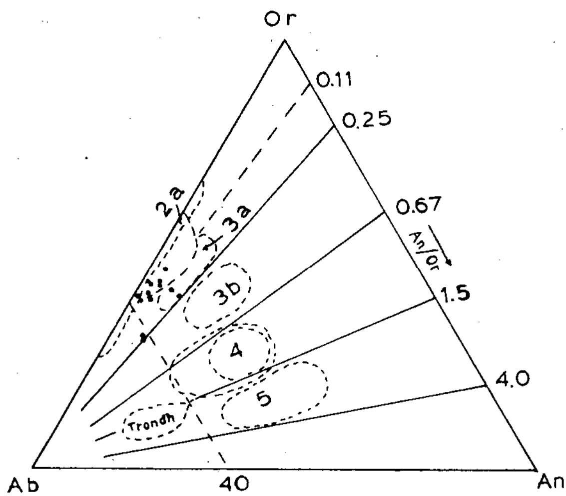


Fig. 13. Triangular diagram for An, Ab, Or normative ratio in granitic rocks [after HIETANEN 1963]

A Kali-granite
B Granite
C Granite trondhjemite
D Trondhjemite
E Quartz-monzonite
F Monzonite
G Tonalite
H Calci-granite
I Granodiorite
J Quartz-diorite
K Calci-monzonite
L Granogabbro
M Gabbro
N Mafic gabbro



ig. **14**. Quartz — feldspar rocks [after STRECKEISEN, 1976]

2a [Alkali-granite, Alkali-rhyolite]
2b [Alkali-feldspar granite, Rhyolite]
3a [(Syeno-) granite, Rhyolite]
3b [(Monzo-) granite, Rhyodacite]
4 [Granodiorite, Dacite]
5 [Tonalite, Plagidacite, Trondhjemite]