ABOUT THE CHEMISMUS OF THE RHYOLITIC OCCURRENCE OF SIDIRONERON, DRAMA, GREECE

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Summary: The chemismus of a volcanic rock (rhyolite) is studied, found by the author in the district of Sidironeron, Drama, Greece. After a brief mineralogical and petrographical examination there are calculated the data of ehemical analyses, the Niggli values, the values of the basis and the ones of Q, L, M, π, γ and μ. On the basis of them the corresponding points are placed on the Q-L-M and Kp-Le-Cal triangles. The norm composition of the rock is caleulated and the eorresponding points of the Niggli values are plotted on differentiation diagrams compared with the differentiation curves of the petrographieal area of Rhodope. It is shown that the examined rock follows with high precision the chemismus of Rhodope. Finally from the Niggli values there is found on the basis of the diagram the composition and ratio of the norm feldspars of the analyzed rock. The composition of the feldspars, calcutated from the values of the analyses, is found to be in agreement with the one optically determined.

1. *Indtroduction*

In the district of Drama and especially in the Elatia forest north of Sidironeron, a volcanic occurrence consisting of rhyolite was found by the author. This rock was studied geologically, mineralogically and petrographically (PAPADAKIS 1972) but no petrochemical data were given. Complete chemical analysis of a specimen of this rock led to the conclusions given further below.

2. *Mineralogical composition and petrographic type of the analysed specimen*

The rhyolite shows a typical porphyritic structure with phenocrysts of sanidine, plagioclase, quartz and a few phenocrysts of biotite.

The ground mass ranges from microcrystalline to cryptocrystalline, and needle - like dendrites are distinguished scattered in it. Afluidal texture is observed in nearly all specimens, together with bending and slipping of the phenocrysts. Cataclastic phenomena are particularly strong in some zones of the rock arranged parallel to one another and interchanged with zones where no cataclastic phenomena are observed. Evidently these zones form regions of magna intrusion into parts of an already solidified rock.

Hydrothermal solutions intruded later into the rock and filled its cavities with a second generation quartz, as well as desmine. They also caused kaolinization of the sanidine phenocrysts while the plagioclase remained unaffected.

The average percentage of the rock is the following:

Biotite	4.33
Quartz	7.12
Sanidine	8.26
Zoned plagioclase of an average composition 32% An	11.87
Ground mass	67.56
Total	100.00

The *sanidine* appears in phenocrysts with prismatic shape elongated paralled to [100]. Twinning is rarely observed. The optical constants are:

extinction angles $n_a : c = 6°$ $n_\gamma : c = 26°$
optical axes angle (—) $2V = 26°$
dispersion $\rho > \upsilon$ strong
optic axial plane amways perpendicular to (010).

According to TUTTLE (1952) is classified in the group of low - sanidine.

The *plagioclase* appears also in phenocrysts, slightly zoned with an average anorthite content 32% (acidic andesine). The multiple twinning follows mainly the laws of Albit - Carslbad, Albit and Carslbad according to the frequency of appearance. Their optical constants are:

optical axes angle (—) $2V = 84°$ $\rho > \upsilon$ strong

Quartz appears in two generations of crystallization, that is: a) as phenocrysts in the ground mass and b) as crystals in cavities of the rock. In the second case quartz has crystallized from thermal solutions which intruded secondarily in the rock.

Zeolite appears topether with quartz in small quantities inside the cavities of the rock. The zeolite is desmine.

Biotite always appears in phenocrysts of pseudo - hexagonal sheets. It shows pleochroism:

n_α = greyish yellow
$n_\beta = n_\gamma$ = dark brownisch yellow to reddish brown

The angle of optical axes is (-) 2V=12° and the refractive indices $\frac{n\beta+n\gamma}{2} = 1.64$. Consequently it is lepidomelane (according to BURKHARDS diagrams in TRÖGER (1956). The reddisch brown colour of the sections is evidently due to titanium in the crystal structure.

Apart from the described minerals there exist also rare crystals basaltic hornblende, sphene, apatite and zirron.

On the basis of the mineralogical composition and structure the rock is characterized as biotitic rhyolite. It must be noted that the examined rhyolite has much in common with the rhyolites discribed by SOLD ATOS (1961), found at the Greek Rhodope, near the Greek - Bulgarian border northeast of Paranestion and north of Stavroupolis. The similarity is especially marked to a specimen from the hill Usounova north of Xanthi. This similarity extends also to the petrochemistry of the two rocks.

3. *Petrochemical observations*

The data of the chemical analysis of the examined rhyolite are given in the following Table 1. For comparison are also given the chemical data of a rhyolite from the district of the Greek - Bulgarian border north of Xanthi.

TABLE 1

Chemical analyses of rhyolites

	1	2
SiO_2	68.95	69.03
Al_2O_3	14.21	14.46
Fe_2O_3	2.57	1.24
FeO	0.65	1.15
MnO	0,09	0,07
MgO	0.99	0.94
CaO	2.42	2.54
Na_2O	3.19	3.46
K_2O	4.03	3.86
TiO_2	0.64	0.33
$+P_2O_5$	0.13	0.12
$+H_2O$	1.65	2.34
$-H_2O$	0.77	0.48
	100.29	100.02

1 : Biotitic rhyolite. Elatia forest, Sideroneron Drama.

2 : Rhyolite with biotite-hornblende and augite. Mountain Usounova, nothern of Xanthi.

Analyzer : 1 D. Konstantinou, Thessaloniki
2 K. Soldatos, Zürich.

From the above numbers of the analysis the Niggli values were calculated as follows:

TABLE 2

Niggli values corresponding to the anFlyses in Table 1

	1	2
si	334.7	338
al	40.5	41.7
fm	19.5	16.6
c	12.6	13.2
alk	27.4	28.6
ti	2.3	1.2
p	0.3	0.3
k	0.45	0.42
mg	0.37	0.41
w	0.76	0.47
q	+125.6	±123.6
al-alk	13.1	13.1
$\frac{2\ alk}{al+alk}$	0.81	0.81
magma	yosemititgranitisch / adamellitisch	yosemititgranitisch

In terms of these values the petrographical type of the volcanic occurrence can be characterized after BURRI (1959) as follows: salic magma, relatively poor in calcium, intermediary alkaline. Petrographic province: pacific type.

From the analyses the following values of the basis are obtained:

TABLE 3

Values of the basis corresponding to the analyses of Table 1

	Q	Kp	Ne	Cal	Sp	Fs	Fa	Fo	Ru	Cp
1	53.6	14.7	17.8	7.1	0.8	2.7	0.9	1.7	0.5	0.2
2	53.6	14.2	19.4	7.3	0.4	1.4	1.5	1.7	0.2	0.3

From the values in Table 3 are obtained the values of L, M, Q, π, γ and μ in Table 4

TABLE 4

Values of L, M, Q, π, γ and μ from the analyses of Table 1.

	L	M	Q	π	γ	μ
1	39.6	6.8	53.6	0.18	0	0.32
2	40.9	5.5	53.6	0.17	0	0.37

Plot of the values of the analyzet rhyolite on a Q, L, M triangle is seen in Fig. 1, and of the values π and $\varkappa$ on α Kp - Ne - Cal triangle in Fig. 2.

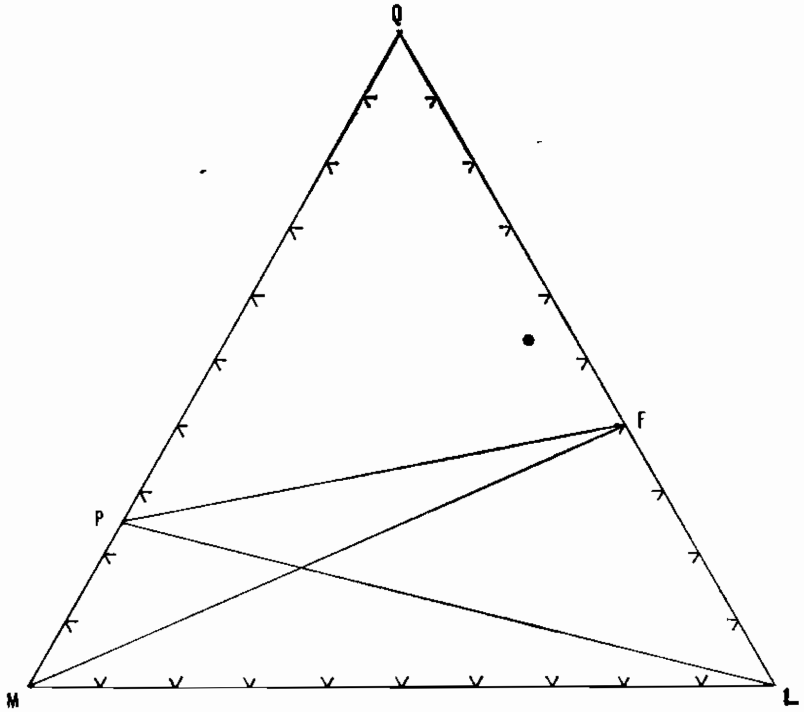

Fig. 1. Plot of the values Q, L, M, of the analyzed rhyolitic specimen

From the values of the basis the norm mineralogical compositions of the analyzed rhyolitic specimen and of the rhyolite from the district north of Xanthi were calculated as follows:

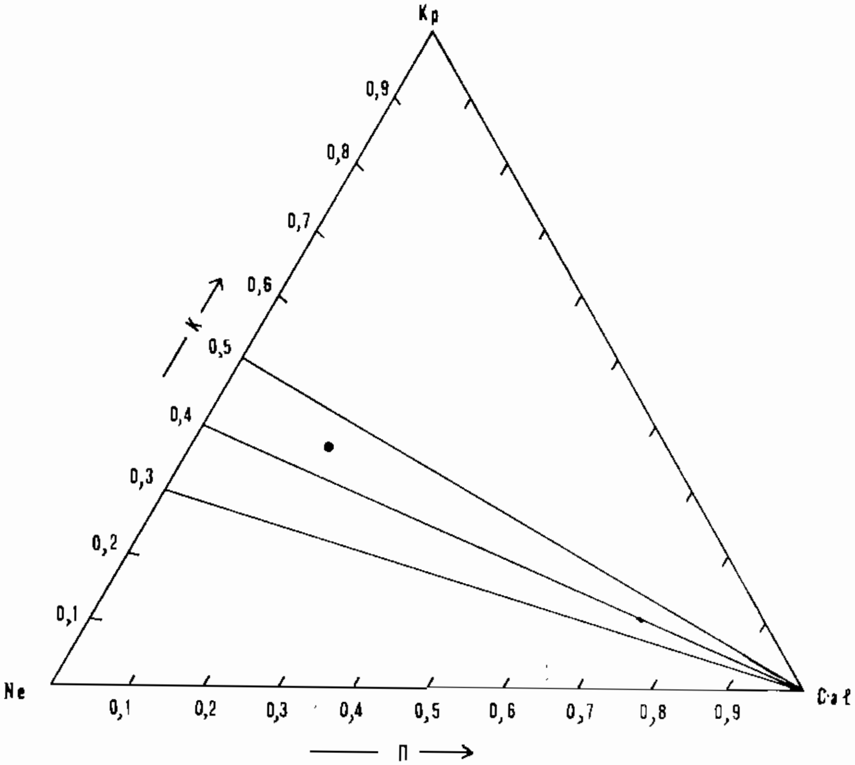

Fig. 2. Plot of π and κ of the analyzed rhyotitie specimen

TABLE 5

Norm mineralogieal composition from the numbers af the basis

	Q	Or	Ab	An	En	Hy	Cord	Mt	Hm	Ru	Cp
1	27.1	24.5	29.7	11.8	2.3	—	1.5	1.8	0.6	0.5	0.2
2	25.8	23.7	32.3	12.2	2.3	1.1	0.7	1.4	—	0.2	0.3

In order to determine exactly the chemistry of the rhyolite under examination in relation to the chemismus of other tertiary volcanic rocks of Rhodope, to which the examined rock belongs the Niggli values of Table 2 are compared with those of the volcanic rocks of Rhodope. (SOLDATOS 1961) examining systematically the chemismus of the magmas of the tertiary volcanic rocks from the Rhodope massive collected the analyses of 40 specimens from Greek Rhodope western Thrace and Samothrace as well as of the districts Orgajden and Malaschewska (Bulgarian Rhodope).

On the basis of the Niggli values from these analyses he drew the differentiation curves of al, fm, c and alk in terms of si. These four curves for values of si up to 250 are given together in Fig. 3

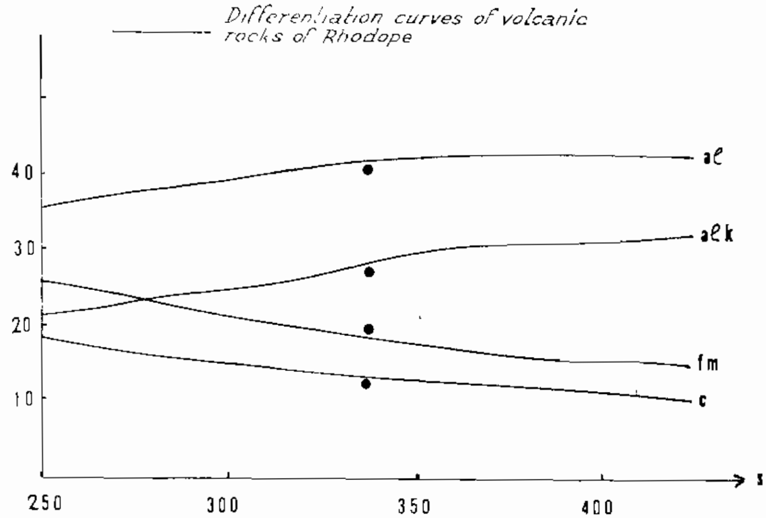

Fig. 3. si-al, si-fm, si-c and si-alk diagrams and composition of their position with the differentiation curves of volcanic rocks of Rhodope

In the same diagram have also been tranferred the points which correspond to the Niggli values of the examined rock. It is remarkable that the points which correspond to the values al, fm, c and alk for si 334,7 of the examined rhyolite are close to the curves of the R hodope rocks, which means that the examined rock is a nearly typical representative of the petrographical area of R hodope.

Fig. 4 is a general representation of the composition and ration of the Norm feldspars of the examined rock, but under the restriction that the SiO_2 is sufficient for the formation of the feldspars, a condition which is fulflled in the examined rhyolite. From the posiotion of the points which correspond to thev alues k and $\frac{2\ alk}{al - alk}$ of the volcanic rock it is derived that its plagioclace have a composition corresponding to acidic andesine, which is in complete agreement with the optically determined composition, which, as mentioned previously amounts to 32 % An (acidic andesine). It is concluded also that the ratio of the alkalifeldspars to the total of feldspars is about 0.36 whereas from point counters results a ratio of sanidine phenocrysts to the whole of the feldspar phenocrysts equal to 0.41. The difference is small and it is explained by the fact that besides the phenocrysts there is also a large

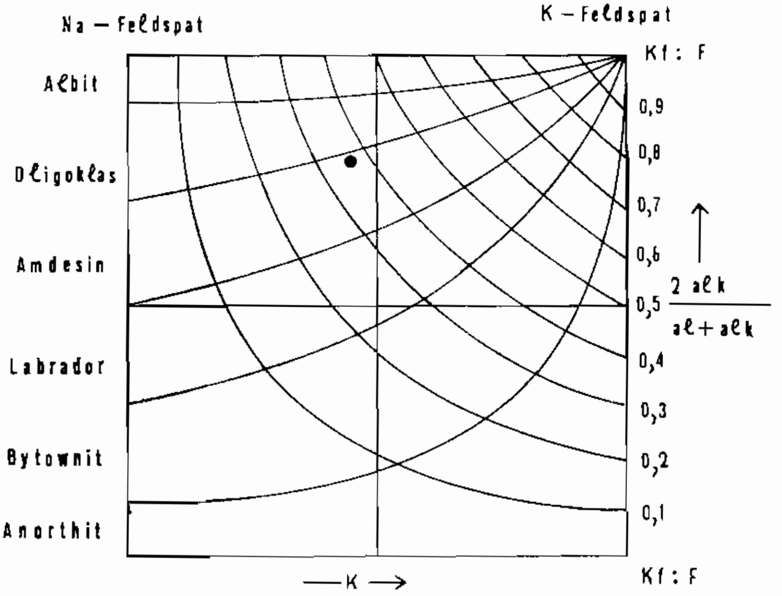

Fig. 4. Composition and ratio of the norm feldspars of the analyzed rhyolite

ground mass (67,56 %), the composition of which is usually different from that of the phenocrysts and consequently alters the average of the mentioned ratio.

ΠΕΡΙΛΗΨΙΣ

ΠΕΡΙ ΤΟΥ ΧΗΜΙΣΜΟΥ ΤΗΣ ΡΥΟΛΙΘΙΚΗΣ ΕΜΦΑΝΙΣΕΩΣ ΣΙΔΗΡΟΝΕΡΟΥ ΔΡΑΜΑΣ

ὑπὸ

ΑΛΕΞΑΝΔΡΟΥ ΠΑΠΑΔΑΚΗ

Μελετᾶται ὁ χημισμὸς ἡφαιστειακοῦ πετρώματος (ρυολίθου) εὑρεθέντος ὑπὸ τοῦ συγγραφέως εἰς τὴν περιοχὴν Σιδηρονέρου Δράμας. Μετὰ σύντομον ὀρυκτολογικὴν καὶ πετρογραφικὴν ἐξέτασιν ἐπεξεργάζονται τὰ δεδομένα τῶν χημικῶν ἀναλύσεων, ὑπολογίζονται τὰ μεγέθη Niggli, αἱ τιμαὶ τῆς βάσεως καὶ τὰ μεγέθη L, M, Q, π, γ καὶ μ. Ἐπὶ τῇ βάσει αὐτῶν τοποθετοῦνται τὰ ἀντίστοιχα σημεῖα εἰς τρίγωνα Q - L - M καὶ Kp - Ne - Cal. Ὑπολογίζεται ἡ δυνητικὴ ὀρυκτολογικὴ σύστασις τοῦ πετρώματος καὶ τοποθετοῦνται εἰς διαγράμματα διαφορισμοῦ si - al, si - fm, si - c καὶ si - alk τὰ ἀντίστοιχα ἐκ τῶν μεγεθῶν Niggli σημεῖα ἐν συνδυασμῷ πρὸς τὰς καμπύλας διαφορισμοῦ τῶν τριτογενῶν ἡφαιστιτῶν τῆς πετρογραφικῆς ἐπαρχίας τῆς Ροδόπης. Ἀποδεικνύεται ὅτι τὸ ὑπὸ μελέτην πέτρωμα ἀκολουθεῖ μετὰ μεγάλης ἀκριβείας τὸν χημισμὸν τῆς Ροδόπης. Τέλος ἐκ τῶν τιμῶν Niggli εὑρίσκεται βάσει διαγράμματος ἡ περιεκτικότης τοῦ πετρώματος εἰς δυνητικοὺς ἀστρίους ὡς καὶ ἡ σύστασις αὐτῶν. Ἡ σύστασις τῶν ἀστρίων ὑπολογιζομένη ἐκ τῶν τιμῶν τῶν ἀναλύσεων εὑρίσκεται εἰς συμφωνίαν μὲ τὴν ὀπτικῶς προσδιορισθεῖσαν τοιαύτην.

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