ABOUT THE CHEMISMUS OF THE ANDESITIC OCCURRENCE OF BOUSALA, DRAMA (GREECE)

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Summary : The chemismus of a volcanic occurrence (andesite) is studied, found by the author in the district of Bousala, Drama, Greece. After a short mineralogical and petrographical examination, there are calculated the data of the chemical analysis of the rock. There are found also the Niggli values, the values of Q, L, M, π, γ and μ, and there are given plots of them on Q-L-M and Kp-Ne-Cal triangles. There are also placed the points which correspond to the Niggli values, on the diagrams si - al, si - fm, si - c and si - alk and their positions are compared in terms of the variation curves of the tertiary volcanic rocks of Rhodope, taken from a paper of SOLDATOS *(1961). It is shown that the examined rock follows the chemismus of the petrographical area of Rhodope, with a slight only deviation being within the dispersion limits of the tertiary volcanic rocks.*

1. Introduction

In this paper is studied the chemismus of a volcanic rock (andesite) found by the author in the district of Busala, Drama, near the Greek - Bulgarian border. The rock has already been investigated geologically, mineralogically and petrographically (PAPADAKIS 1972). A recent complete chemical analysis of it, led to conclusions about its chemismus, which are gives below.

2. Mineralogical composition and petrographical type.

The andesite of the district Busala, Drama shows the following percentage composition:

Augite	9.31
Hypersthene	3.26
Plagioclase of an average composition 43% An	23.67
Cristobalite	3.06
Accessory minerals	1.14
Ground mass	59.56
Total	100.00

Augite appears idiomorphic with crystals to 1.5 mm long. It develops mainly the faces (100), (010) and (110) and has a tabular shape. It appears in simple crystals as well as twins on (100) and ($\bar{1}22$) and sometimes there is multiple twinning. It is slightly pale - green with weak pleochroism. The optical constants are:

Extinction angle	$n_\gamma : c = 40°$
optical axes angle	$2V = 52°$

dispesion $\rho > \upsilon$ weak, without any difference in the two optical axes. Optic axial plane parallel to (010). Hence the mineral is common augite (TRÖGER 1967).

Hypersthene occurs in small phenocrysts, with the usual tabular form. It shows weak pleochroism:

n^α = pale greenish - yellow
n_β = pale greenish - pink
n_γ = pale smoky - green

Occasionally it shows a starting serpentinization. Exolution of ilmenite lamellae or klinohypersthene were not observed. Sometimes crystals appear consisting of a hypersthene core surrounded by augite.

The *plagioclase* occurs as phenocrysts of a size from 0.8 to 2 mm. They are zoned with a small anorthite content difference between the core and the rim. Their twinning and multitwinning correspond to the following laws in frequency of occurrence: Albit - Carlsbad, Albit and Carlsbad. The periclin or other more complex laws appear more rarely (Albit - Ala etc). The optical data are:

optical axes angle $2V = 80°$
dispersion $\rho < \upsilon$ weak

the average content in anorthite was calculated to 43 % (andesine).

Cristobalite occurs in cavities or in cracks of the rock, consequently it was transported there by solutions after the solidification of the rock. It shows a very weak relief and the characteristic spheroidal texture.

The structure of the rock is porphyritic with phenocrysts of the described minerals augite, hypersthene and plagioclase. The ground

mass is nearly glassy. Small needlelike crystals of plagioclase can be distinguished in it with difficulty (second generation of crystallization). Apatite and Magnetite occur as accessory minerals. According to the mineralogical composition and the structure we must characterize the rock as augite - hypersthene - andesite, while according to the Niggli values from the analyses and the chemismus of the magma (tonalitisch) we may characterize it as cryptodakite.

3. Petrochemical observations

The chemical analysis of the rock is given in Table 1

TABLE 1

Chemieal analysis of andesite

SiO_2	57.4
Al_2O_3	17.71
Fe_2O_3	4.27
FeO	2.35
MnO	0.16
MgO	3.07
CaO	5.95
Na_2O	2.25
K_2O	2.07
TiO_2	1.32
P_2O_5	0.24
$+H_2O$	2.0
$-H_2O$	1.56
Total	100.35

The corresponding Niggli values are as follows:

TABLE 2

Niggli values corresponding to the analusis of Table 1

si	190
al	34.6
fm	32.8
c	21.1
alk	11.5
ti	3.2
p	0.2
k	0.38
mg	0.46
w	0.6
al-alk	23.1
$\frac{2\ alk}{al+alk}$	0.5
magma	tonalitisch

On the basis of these data we may classify the petrographical type of the volcanic occurrence according to BURRI (1959) as follows: peralfemisch magma, normal in calcium content, relatively poor in alkalis. Petrographic province: pacific type.

The data in Table 1 give the values of the basis listed in Table 3

TABLE 3

Values of the basis corresponding to the analysis of Table 1

Q	Kp	Ne	Cal	Sp	Fs	Fa	Fo	Ru	Cp
44.7	7.7	12.6	17.7	2.6	4.8	3.1	5.4	0.9	0.5

From these numbers are derived the values of L, M, Q, π, γ, and μ given in Table 4

TABLE 4

Values of L, M, Q, π, γ, and μ corresponding to the data of Table 3

L	M	Q	π	γ	μ
38	17.3	44.7	0.47	0	0.41

A plot of the values of the analyzed volcanic specimen on a Q-L-M triangle is given in Fig. 1 and a plot of the values π and $\varkappa$ on the triangle Kp-Ne-Cal in Fig. 2

Plot of the values Q, L, and M of the analyzed volcanic specimen

From the values of the basis the norm mineralogical composition of the rock was calculated and is given in Table 5

TABLE 5

Norm mineralogical composition of the analyzed specimen corresponding to the values of the basis

Q	Or	Ab	An	En	Hy	Cord	Mt	Ru	Cp
17.6	12.8	29.5	21	7.2	0.9	4.8	4.8	0.9	0.5

In order to determine exactly the chemismus of the rock in terms of the chemismus of the tertiary volcanic rocks of the Rhodope district to which the examined rock belongs, use was made of the variation diagrams of the Rhodope volcanic rocks, taken from a paper of SODATOS (1961). He constructed those diagrams with data of chemical analyses of 40 volcanic specimens from the districts of Greek Rhodope

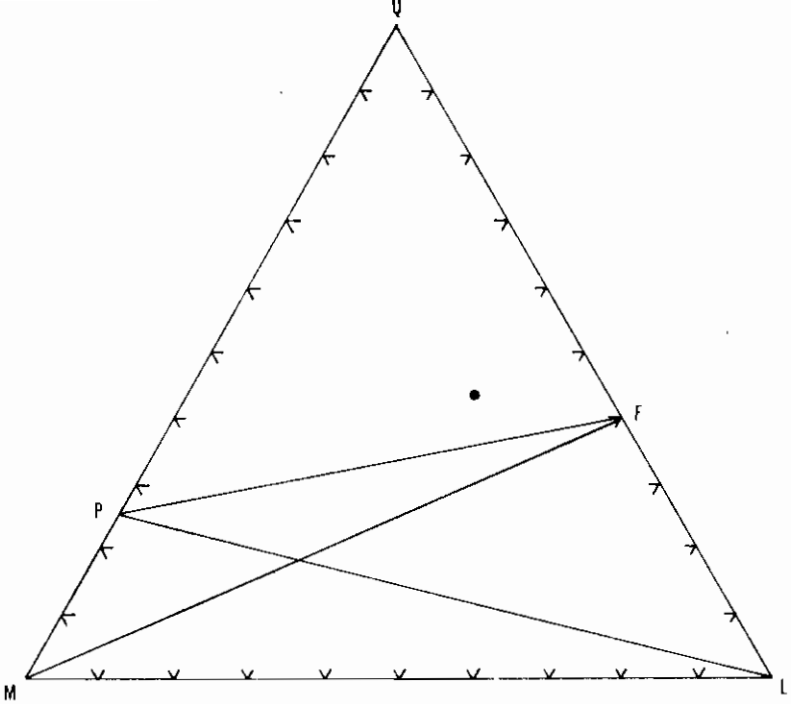

Fig. 1. Plot of the values Q, L, and M of the analyzed volcanic specimen

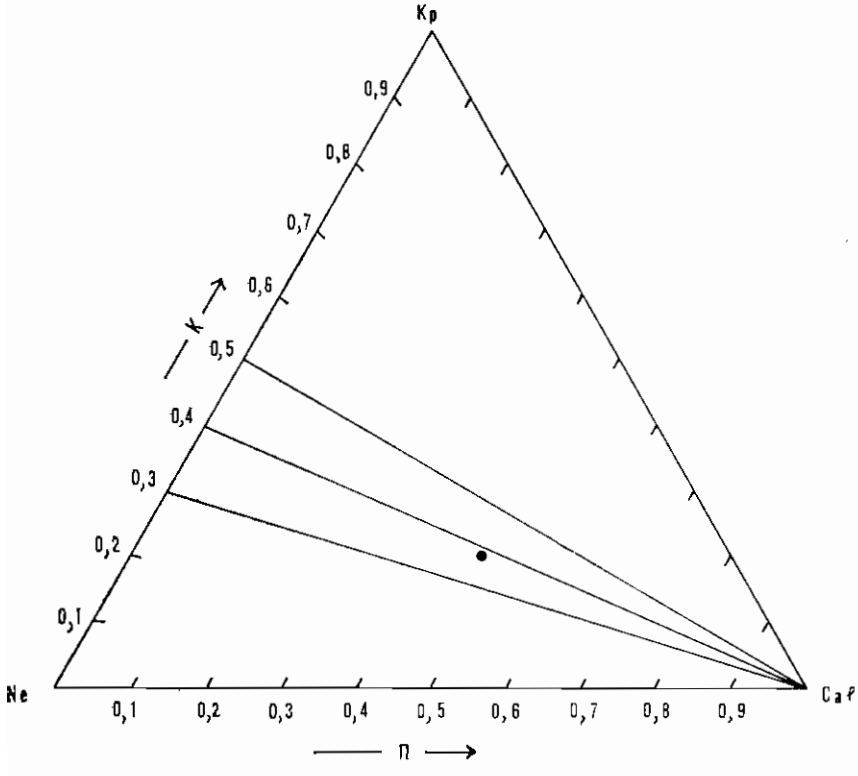

Fig. 2. Plot of the values π and κ of the analyzed volcanic specimen

western Thrace and Samothrace, as well as from the districts of Ograjden and Malaschewska (Bulgarian Rhodope). On the variation diagrams represented in Fig 3 for values of si ranging from 250 to 400, were tran-

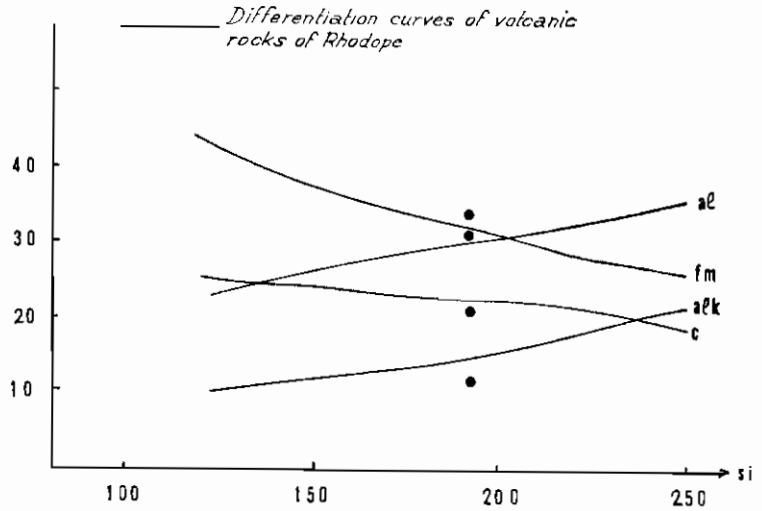

Fig. 3
si-al, si-fm, si-c and si-alk diagrams and composition specimen of their position with the differentiation curves of volcanic rocks of Rhodope

ferred the points corresponding to the Niggli values of the rock under consideration. It can easily be seen that the Niggli values are at some distance from the individual variation curves for al, fm, c and alk (functions of si) but the deviation is within the dispersion limits of the tertiary Rhodope volcanic rocks, shown in Fig. 27, page 77 of the paper by Soldatos (1961). Hence it can be said that the examined rock follows the chemismus of the tertiary Rhodope volcanic rocks. An important difference appears only in the Niggli value ti, which was calculated according to the analysis as 3.2, while the average of the values ti for Rhodope volcanic rocks does not exceed the value of 1.51.

ΠΕΡΙΛΗΨΙΣ

ΠΕΡΙ ΤΟΥ ΧΗΜΙΣΜΟΥ ΤΗΣ ΑΝΔΕΣΙΤΙΚΗΣ ΕΜΦΑΝΙΣΕΩΣ ΜΠΟΥΖΑΛΑΣ, ΔΡΑΜΑΣ

ὑπὸ

ΑΛΕΞΑΝΔΡΟΥ ΠΑΠΑΔΑΚΗ

Μελετᾶται ὁ χημισμὸς ἡφαιστειακῆς ἐμφανίσεως εὑρεθείσης ὑπὸ τοῦ συγγραφέως εἰς τὴν περιοχὴν Μπουζάλας Δράμας. Μετὰ σύντομον ὀρυκτολογικὴν καὶ πετρογραφικὴν ἐξέτασιν, ἐπεξεργάζονται τὰ δεδομένα χημικῆς ἀναλύσεως τοῦ πετρώματος. Ὑπολογίζονται τὰ μεγέθη Niggli αἱ τιμαὶ τῆς βάσεως τὰ μεγέθη L, M, Q, π, γ καὶ μ καὶ δίδονται προβολαὶ αὐτῶν εἰς τρίγωνα L - M - Q καὶ Kp - Ne - Cal. Ἐπίσης τοποθετοῦνται τὰ σημεῖα τὰ ἀντιστοιχοῦντα εἰς τὰς τιμὰς Niggli εἰς διαγράμματα si - al, si - fm, si - c καὶ si - alk καὶ συγκρίνονται αἱ θέσεις αὐτῶν ἐν σχέσει πρὸς τὰς καμπύλας διαφορισμοῦ τῶν τριτογενῶν ἡφαιστιτῶν τῆς Ροδόπης, ληφθείσας ἐκ τοῦ ΣΟΛΔΑΤΟΥ (1961). Δεικνύεται ὅτι τὸ ἐξετασθὲν πέτρωμα ἀκολουθεῖ μὲ μικρὰν ἀπόκλισιν, εὑρισκομένην ἐντὸς τῶν ὁρίων διασπορᾶς τῶν τριτογενῶν ἡφαιστιτῶν, τὸν χημισμὸν τῆς πετρογραφικῆς ἐπαρχίας τῆς Ροδόπης.

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