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MINERALOGICAL AND PETROLOGICAL CHARACTERISTICS OF ANDESITE ROCKS NEAR THE VILLAGE OF RATAVICA

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A b s t r a c t: The paper presents mineralogical and petrological characteristics of andesite rocks near the village of Ratavica. Simples were collected 2 m from one another.

Preparation of simples was made at the Faculty of Mining and Geology Štip. Determination of macroelements and trace elements in rocks and minerals was done by AES-ICP.

Key words: andensite; dacite; augite; plagiclase; andensine; hornblende; biotite; quartz

INTRODUCTION

The samples of volcanic rocks studied are part of the large Kratovo–Zletovo volcanic area that occupy the north-eastern parts of the Republic of Macedonia. There are numerous data regarding the investigation of these volcanic rocks Bogoevski 1964, Ivanov 1965; Ристић 1973; Janković 1972, 1974; Pantić et al., 1972, Marić 1953; Mijalković et al., 1964; Tomić 1938; Серафимовски, 1990.

RESULTS AND DISCUSSION

Simples of andesites are dark grey-green colour. They are compact rocks with porphyritic structure and massive textures. They possess columnar leaching. At the base they have phenocrystals of hypidiomorphic plagioclase, idiomorphic and hypidiomorphic grains of augite and metallic minerals. All simples have similar characteristic and colour.

Chemical composition of andesite rocks were determined by AES_ICP in the laboratoy on Faculty of Mining and Geology in Štip. Results are given in Tables 1 and 2.

Figure 1 shows that investigated rocks are on the border between trachy-andesites and dacites.

For better presentation of data of macroelements several Harcker diagrams were made (Fig. 2).

The diagrams show that TiO_2, FeO, CaO, K_2O, MnO components occur as fairly equivalent concentracions.

Greater oscillations haven been found in P_2O_5 and MgO.

Table 1

Chemical composition of andesite rocks near the village of Ratavica determined by AES-ICP

	1	2	3	4	5	6
Al_2O_3	15.29	14.83	15.69	15.89	15.81	15.58
CaO	3.84	5.10	5.08	5.02	4.59	5.04
MgO	1.46	2.40	2.85	3.00	3.58	4.03
FeO	6.20	5.02	5.45	5.41	5.37	5.56
Na_2O	4.30	4.35	4.79	4.61	4.67	4.53
K_2O	3.34	3.07	3.34	3.34	3.35	2.61
TiO_2	0.559	0.487	0.571	0.579	0.546	0.544
MnO	0.116	0.109	0.102	0.098	0.098	0.103
P_2O_5	0.266	0.236	0.264	0.225	0.243	0.241
SiO_2	64.3	64.33	61.89	61.8	61.72	61.85
Suma	99.67	99.93	100.03	99.97	99.98	100.09

Table 2

Presence of trace elements in andesites rocks

Ppm	1	2	3	4	5	6
Sr	6.38	6.68	9.17	7.69	7.69	7.86
Ba	7.71	8.90	8.93	8.12	8.13	8.57
Ni	40.97	37.92	42.69	40.64	36.98	42.96
Zn	74.34	64.13	79.07	75.03	63.69	63.92
Cr	81.46	58.74	76.74	88.41	66.30	82.39
Cu	35.96	78.35	36.68	37.93	37.86	31.98
Pb	44.81	58.74	47.99	46.40	46.51	48.11
Cd	5.96	4.43	5.54	6.26	5.24	5.24
Co	17.98	18.41	20.22	17.62	20.62	17.90
V	190.44	158.00	174.46	193.63	157.51	196.69
As	35.34	11.85	11.27	19.93	0.02	7.71

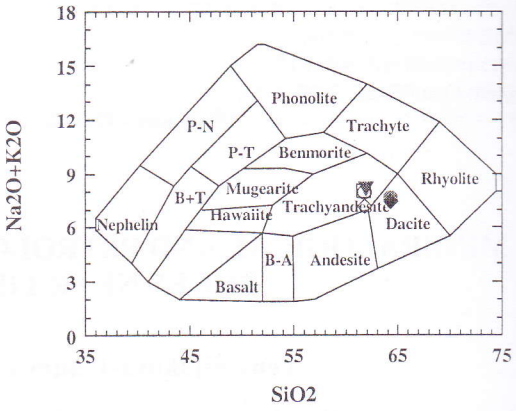

Fig. 1. Classification of rocks by Le Maitre, 1976

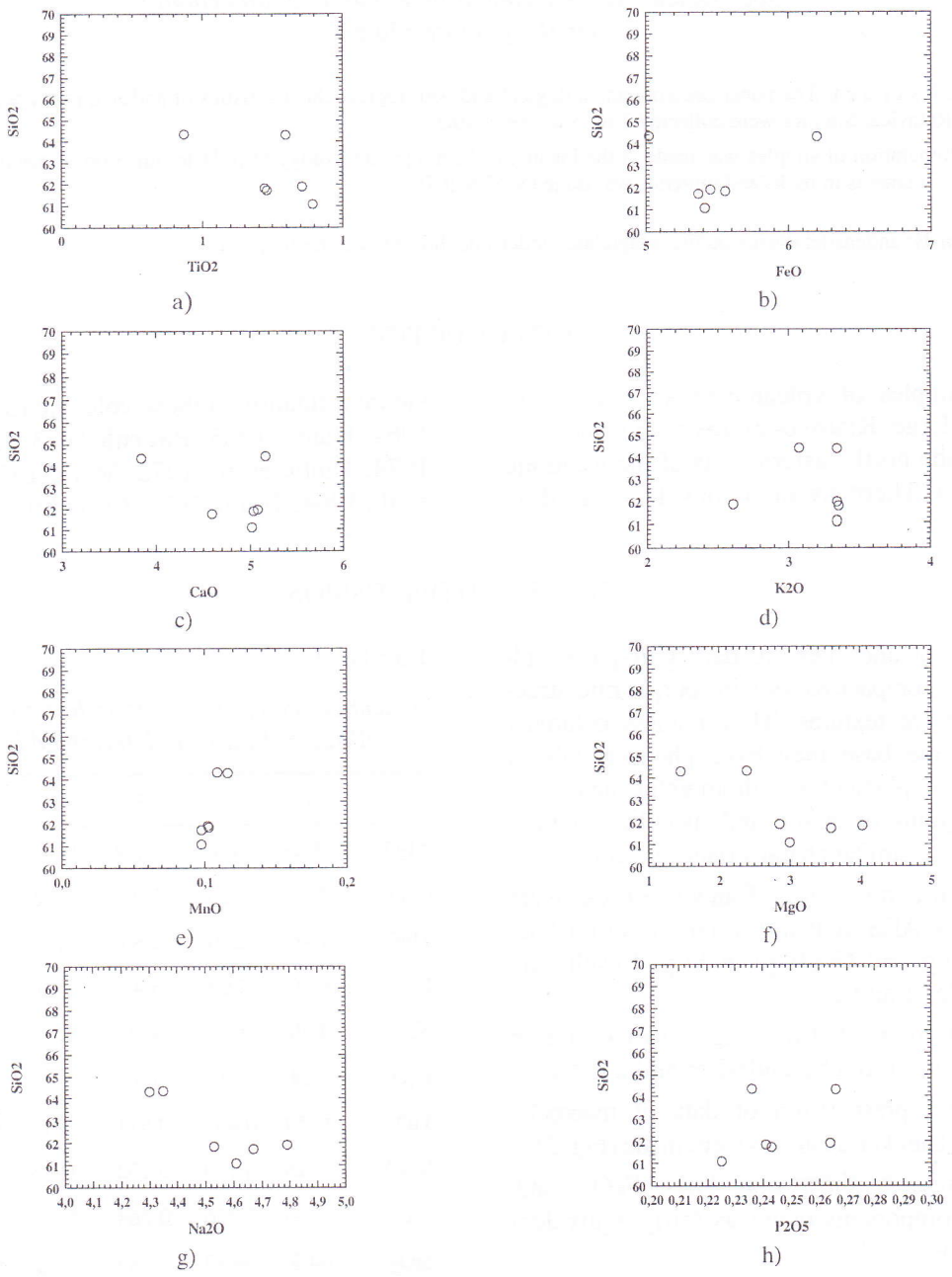

Fig . 2. Harckers diagram SiO_2
a) TiO_2; b) FeO; c) CaO; d) K_2O; e) MnO; f) MgO; g) Na_2O; h) P_2O_5

MICROSCOPIC FEATURES

These rocks have porphyritic structure.

The following minerals were determined: augite, andensine, hornblende, biotite and quartz.

Augite is light green, green up to brown. Grain size attains 1 – 2 mm. Interference colours are of second order (Fig. 3). It possesses high relief. Optically is positive. Maximum angle of tarnish is 45 – 54°.

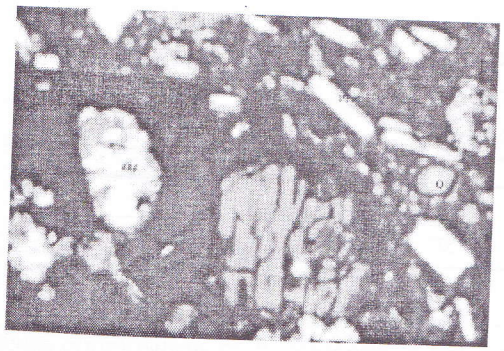

Fig. 3. Microphotograph of augite and quartz (× 10, N^+)

The chemical composition of augite is given in Table 3.

On the basis of the results obtained the classification was made of pyroxene by Morimoto et al., 1988 (Fig. 4). Figure 4 shows that investigated pyroxene is augite.

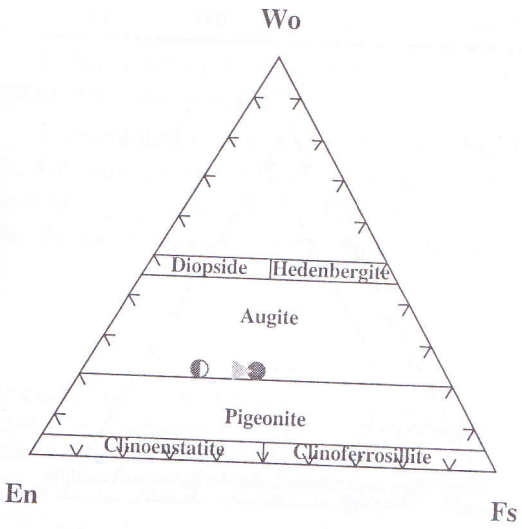

Fig. 4. Classification of pyroxene by Morimoto et al.1988

Table 3

Chemistry of augite determined by AES-ICP

		1	2	3
SiO_2		49.911	49.993	49.653
TiO_2		1.476	1.584	1.542
Al_2O_3		3.28	3.42	3.36
FeO		10.68	19.80	18.40
Fe_2O_3		–	–	–
Cr_2O_3		–	–	–
MnO		0.107	0.131	0.124
NiO		–	–	–
MgO		12.92	12.41	13.20
CaO		7.678	9.702	9.80
Na_2O		2.68	2.62	2.53
K_2O		0.222	0.314	0.311
Suma		98.954	99.974	98.92
		1	2	3
T.pos	Si	2.061	1.882	1.878
	Al	0.000	0.118	0.122
		2.061	2.000	2.000
	Al	0.159	0.034	0.028
	Ti	0.046	0.045	0.044
	Fe_3	0.000	0.000	0.000
	Fe_2	0.000	0.225	0.184
	Cr	0.000	0.000	0.000
	Mg	0.795	0.696	0.744
	Ni	0.000	0.000	0.000
	Mg	0.001	0.000	0.000
	Fe_2	0.369	0.398	0.398
	Mn	0.004	0.004	0.004
	Ca	0.340	0.391	0.397
	Na	0.215	0.191	0.186
	K	0.012	0.016	0.015
M_1M_2		1.941	2.000	2.000

Contents of trace elements in augite are determined by AES-ICP . Results are given in Table 4.

Table 4

Contents of trace elements in augite

Elements	1	2	3
Ag	5.196	9.29	7.13
Sr	398.994	454.45	421.04
Cu	55.99	205.66	130.18
Ni	179.05	228.96	201.13
Mn	0.107	0.131	0.124
Cr	383.61	374.22	380.01
V	668.08	729.06	691.15
P	0.056	0.094	0.070
Zn	661.06	1620.24	932.81
Pb	23.25	183.42	49.92
Cd	12.35	16.53	14.41
Co	69.80	70.77	71.41

Andensine is most present in the rocks. In thin section is colourless. Appear in idiomorphic grains. Twins can often be found. Size of grains is 1–1.5 mm. Interference colour is white of second order. There are two perfect cleavages on (001) and (010) (Fig. 5).

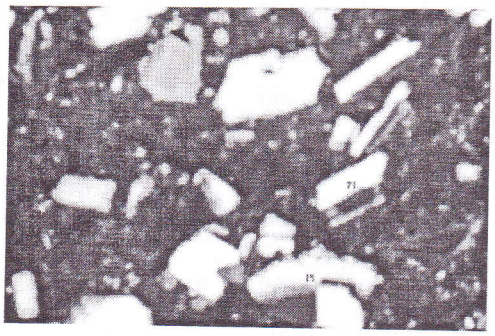

Fig. 5. Microphotograph of andensine (× 10, N^+)

Table 5 shows chemical composition of andensine of andesites rocks of Ratavica.

Chemical composition of andensine is shown in the diagram for the classification of plagioclase by Deer et al., 1967a (Fig. 6).

Contents of trace elements in andensine is given in Table 6.

Table 5

Chemical composition of andensine

	1	2	3
SiO_2	58.678	58.789	59.12
TiO_2	0.138	0.109	0.120
Al_2O_3	24.46	23.961	23.67
Fe_2O_3	–	–	–
FeO	0.91	0.87	0.95
MnO	0.048	0.047	0.041
MgO	0.38	0.37	0.039
BaO	–	–	–
CaO	7.32	7.48	7.14
Na_2O	7.73	7.69	7.22
K_2O	1.21	1.13	1.18
Suma	100.874	100.446	99.48

	1	2	3
Si	10.532	10.591	10.715
Al	5.170	5.084	5.052
Fe_3	0.000	0.000	0.000
Ti	0.019	0.015	0.016
Fe_2	0.137	0.131	0.144
Mn	0.007	0.007	0.006
Mg	0.102	0.099	0.011
Ba	0.000	0.000	0.000
Ca	1.408	1.444	1.386
Na	2.690	2.686	2.537
K	0.277	0.260	0.273
Cations	18.000	18.000	18.000
Ab	66.7	66.7	66.7
An	33.3	33.3	33.3
Or	0.0	0.0	0.0

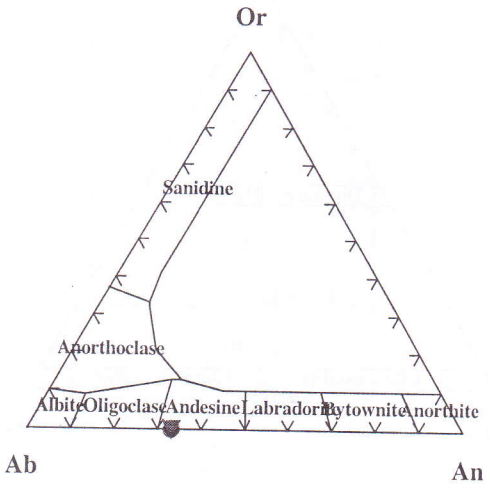

Fig. 6. Classification of andensine by Deer et al., 1967

Table 6

Contents of trace elements in andensine determined by AES-ICP

	1	2	3
Ag	800.11	762.19	810.16
Sr	1042.15	936.3	998.42
Cu	64.87	60.90	62.38
Ni	–	–	–
Mn	0.045	0.031	0.050
Cr	–	–	–
V	177.48	179.99	169.23
P	0.114	0.128	0.102
Zn	103.94	98.79	110.12
Pb	13.18	15.22	11.76
Cd	6.63	9.18	5.96
Co	23.72	20.56	29.03

Hornblende – this term is useful because chemical composition of hornblende is not determined. Hornblende was determined only macroscopy and microscopy. The colour is green-brown. Interference colours are of second order. Pleochroism is different tint on green. It possesses high relief (Fig. 7).

Biotite is very litle presents in the rock. Size of grains is 0.2 – 0.4 mm. Appears in idiomorphic crystals. Translucent, pleochroic in yellow and yellow-brown, greenish brown, dark brown, red brown.

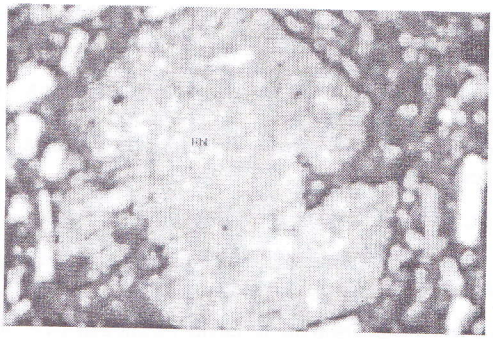

Fig. 7. Microphotograph of hornblende (× 10, N⁺)

Quartz – in thin section is clear and colourless (Fig. 8). Appears in small xenomorphic grains of 0.3 – 0.8 mm in size. It possesses low relief and grey interference colour. Optically is positive.

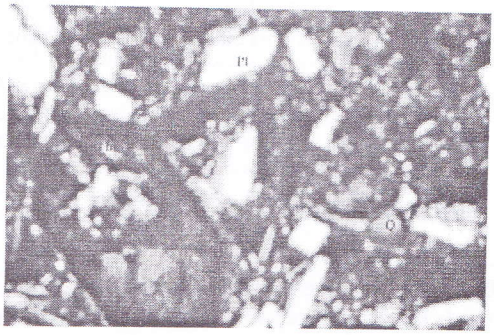

Fig. 8. Microphotograph of biotite and quartz (× 10, N⁺)

Metallic minerals are present in as small grains with black colour.

CONCLUSION

From what has been said above the following conclusions can be made :

Investigated rocks have dark green-black colour. Structure is porphyritic and texture is massive. They are very hard and heavily detatchable simples. In these rocks are determined the following minerals: augite, andensine, hornblende, biotite, quartz and metallic minerals. The result of mineralogical and petrological investigation determined that these rocks are the border between trachyc andesite and dacite. Earlier investigations determined that these rocks were andesite.

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Резиме

МИНЕРАЛОШКО-ПЕТРОГРАФСКИТЕ КАРАКТЕРИСТИКИ НА АНДЕЗИТСКИТЕ КАРПИ ВО БЛИЗИНА НА СЕЛОТО РАТАВИЦА

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Клучни зборови: андезити; дацити; аугит; андензин; хорнбленда; биотит; кварц

Во овој труд се презентирани минералошко-петрографските карактеристики на андезитските карпи во близина на селото Ратавица. При теренските истражувања се земени околу десетина примероци на меѓусебно растојание од околу 2 m.

Макроскопски примероците се со темносиво зеленикаста боја. Тие се доста цврсти и од нив тешко може да се одвои парче. Имаат порфирска структура и масивна текстура. Микроскопски во нив се определени следниве минерали: аугит, андензин, хорнбленда, биотит, кварц и метални минерали.

Од страна на претходните истражувачи овие карпи беа третирани како андезитни. Според нашите податоци, добиени со минералошките и петрографските испитувања, овие карпи се наоѓат на границата помеѓу трахиандезити и дацити.