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GEOLOGY, PETROGRAPHY AND GEOCHEMISTRY OF THE OLIGOCENE ACID VOLCANITES OUTCROPING WEST OF SMOLIAN (CENTRAL RHODOPES) AND THEIR APPLICATION AS BUILDING AND DECORATION MATERIAL

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ABSTRACT. The investigated volcanic rocks are located in the Smolian region. These magmatic products are of rhyolitic and of high-K composition. They are probably of Oligocene age.The main phenocrysts in the rhyolites are represented by plagioclase, K- feldspar, quartz, biotite and muscovite. The ground mass is microlitic and glassy. Similar rock materials are used as building material, roof tails productian, house facing, decorative pavement production, etc. in the past in the area of the Rhodopes and other parts of Bulgaria. Hewn stone materials of thise type are used in the present too. They are popular in new houses building and touristic objects. Similar rocks of decorative quality as studied rhyolites are popular for production of material used in pavement production, house facing, as roof tails, interior and exterior decoration, etc.

ГЕОЛОГИЯ, ПЕТРОГРАФИЯ И ГЕОХИМИЯ НА ОЛИГОЦЕНСКИТЕ КИСЕЛИ ВУЛКАНИТИ, РАЗКРИВАЩИ СЕ НА ЗАПАД ОТ СМОЛЯН (ЦЕНТРАЛНИ РОДОПИ) И ТЯХНОТО ПРИЛОЖЕНИЕ КАТО СТРОИТЕЛНИ И ДИКОРАТИВНИ МАТЕРИАЛИ

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РЕЗЮМЕ. Разглежданите магмени скали се намират в района на гр. Смолян. Те са с риолитов и високо калиев състав. Възрастта им е вероятно олигоценска. Порфирната генерация е изградена основно от плагиоклаз, калиев фелдшпат, кварц, биотит и мусковит. Основната маса е микролитова и стъклена. Подобни скали са се използвали в миналото като строителни материали, за изготвяне на плочи за покрития на покривни, облицовки на жилищни и други сгради, декоративни настилки и други, както в пределите на Родопите, така и в други части на страната. Цепените каменни изделия от този тип се използват и сега, като има повишен интерес към тях при изграждането на нови жилищни сгради и туристически обекти. Тази суровина и подобни на нея се ползват с голяма популярност при изпълнението на вътрешни и външни облицовки в много европейски страни.

Introduction

The aim of present investigation is to present new geological, petrographical, pertological and geochemical data about the studied volcanic complex, located in the Rhodopes near Smolian town, and to describe traditional and new usage of this and similar rocks as building and decoration materials.

Geological setting and petrology of the investigated magmatic complexex

The present study is focused on the petrological and geochemical characteristics of the volcanics outcrop in the Smolian region. The main aim of this investigation is to reconstruct the geological evolution of the Oligocene volcanic complex and to outline traditional and new usage of these rocks as building and decoration materials. Combined field observations with representative whole rock major and trace element analyses are used in present study.

Geological background and sampling

The Rila-Rhodope unit of the Morava-Rhodope zone (Dabovski et al., 2002; Fig. 1) exhibits high-grade metamorphic rocks (Prerhodopian and Rhodopian supergroups (Kozhoukharov et al., 1984) intruded by several large Palaeozoic and Late Cretaceous granite plutons, followed by Oligocene? “minor” intrusions. They are covered by thick Palaeogene volcano-sedimentary successions (Kozhoukharov et al., 1992; Fig. 2). This is the unit with thickest (40-52 km) continental crust in Bulgaria.

The basement of the volcanic rocks consists of metamorphic rocks (biotite and two-mica schists and marbles of the Dobrostan Formation (Kozhoukharov, 1984). The Oligocene succession in the region starts with conglomerate – sandstone formation. It coveres transgresively the metemorphic basement. This formation is built up by thick sandsones, conglomerates, intercalated by argilites and alevrolites. Thin grey linestones are described in the Cherna river valley in the conglomerate – sandstone formation. It is normaly covered by the coal-bearing formation. The last one is built up by conglomerates, marls and sandstones. It is normaly covered by the volcanogenic – sedimentary formation (tuffs, sandstones, tuff-breccias, etc.) in the region. This formation is of Middle Oligocene age

(Stefanov et al., 1974). They are partly covered by volcanites, mostly of rhilitic composition.

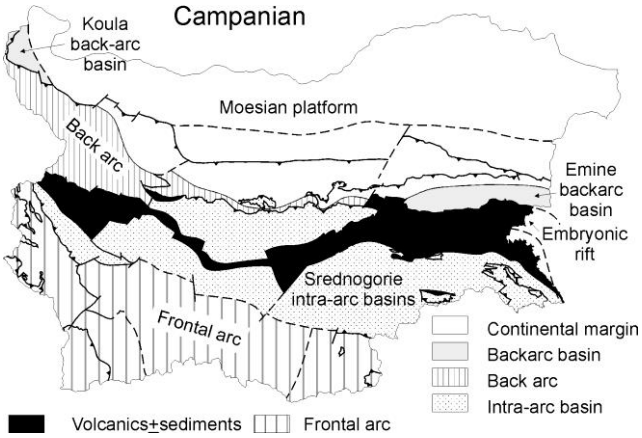

Fig. 1. Tectonic reconstruction of Bulgaria for the Oligocene (after Dabovski et al., 2002)

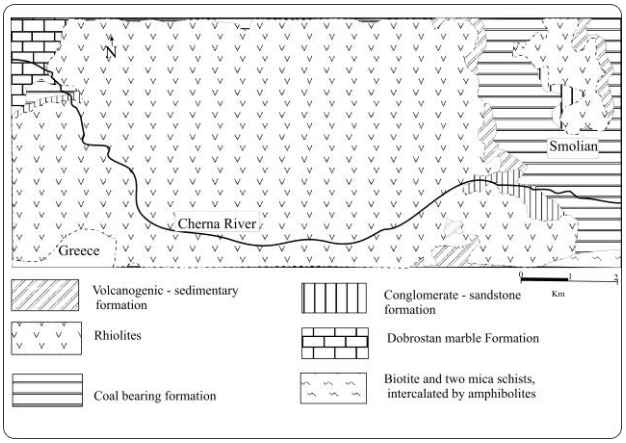

Fig. 2. Geological map of the area eastern of Smolian (after Kozhoukharov et al., 1992 modified by the author)

Petrography

The volcanites in the studied region are presented mainly by lava flows and necs. They are utcope as joined columns and plates in the upper most part of the section. These rhyolites are pink, pink-grey to grey on colour. The pink colour rhyolites are strong, their phenocrysts consists of plagioclase, K – feldspar, quartz, biotite, muscovite and amphibole up to 5 mm on size. Accessory minerals are presented by titanite and apatite, secondary ones by clay minerals and carbonates. These rhyolites are of high degree of crystallization (2:1 to 3:1 porphyries to ground mass). Some of the phenocrysts are plastically deformed to partly fractured (Fig. 3). The plagioclase crystals are from 1.5 to 5 mm in size. In some cases they are partly replaced by carbonates. The K-Feldspar (sanidine) crystals are from 1.5 to 2 mm in size. They are fractured. The quartz phenocrysts are strongly deformed and fractured. They are from 1.5 to 3 mm in size. Amphibole and biotite crystals are relatively rare. The second one is presented by deformed phenocrysts.

The ground mass is flow-banded to fluidal and hyaline (Fig. 4). It is of a brownish colour.

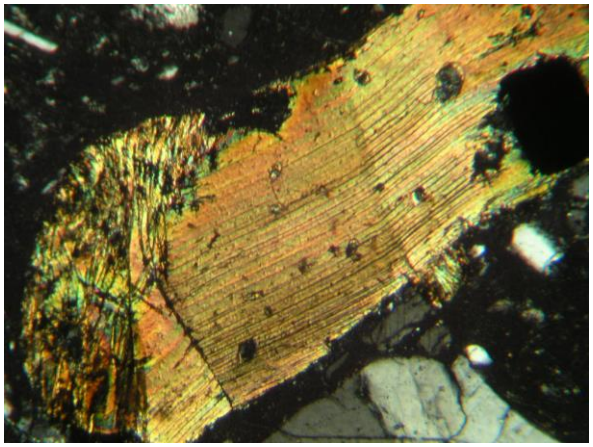

Fig. 3. Microscope image of thinsection from the grey rhyolites (image size 1.5 mm) deformed biotite crystal

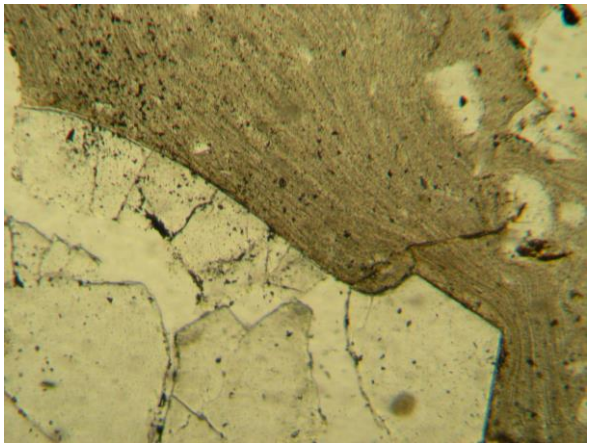

Fig. 4. Microscope image of thinsection from the grey rhyolites (image size 1.5 mm) deformed groundmass crystal

The grey rhyolites are of similar petrography. They are characterized by relatively higher degree of deformation of the biotite crystals and presence of deformed volcanic glass in the groundmass.

Analytical techniques

Major and trace elements

Part of major and trace elements were analyzed by X-ray fluorescence (XRF) at the University of Lausanne, Switzerland. The other part was analyzed by ICP-atomic emission spectrometry in the University of Mining and Geology "St. Ivan Rilski". A petrologic study has also been performed. The representative analyses of the compositional variation of the rock recovered from the studied volcanics are given in Tables 1 and 2.

Chemical composition of the volcanic rocks

The SiO_2 content in the analyzed rock samples veries from 73.89 to 75.59 wt.%, K_2O from 2.53 to 5.10 wt.% and Na_2O form 2.64 to 6.01 wt.%.

Studied volcanic rocks are classified as rhiolites after Le Maitre et al., 1989 classification diagreme (Fig. 5). All analyzed reprezentative rock samples are high-K (Fig. 6).

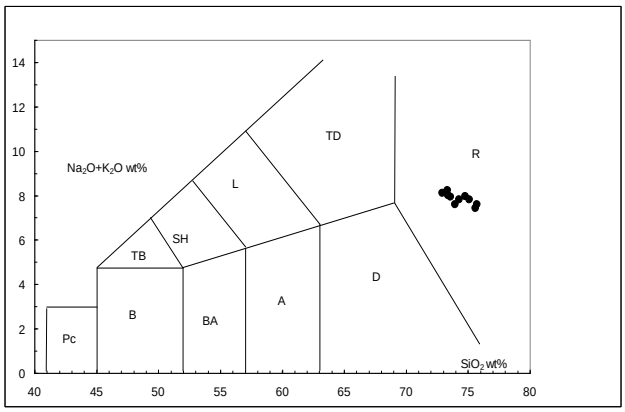

Fig. 5. TAS diagram after Le Maitre (1989) for representative samples from the studied region (B – basalt; BA – basaltic andesite; A – andesite; D – dacite; SH – shoshonite; L – latite; T D– trachydacite; R – rhyolites)

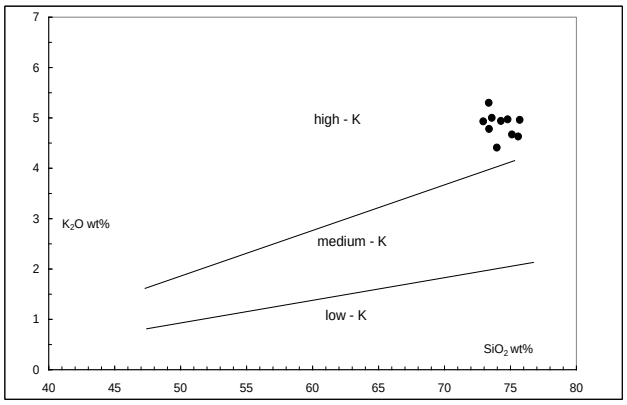

Fig. 6. SiO_2 vs. K_2O diagram after Le Maitre (1989) for representative samples from the investigated volcanites

Bulk rock trace elements composition

The MORB normalized patterns for the investigated magmatic rokcs (Table 1 and 2, Fig. 7) indicate enrichment of LILE and in lesser degree of some HFSE (Ce, Zr, and Hf). All these features are sililat to there for subduction-related magmatic sequences due to the melting of sedimentary material of the subducted slab. The grey color rhyolites show slightly increased content of elements as show relatively increased Sr, Ce, Ba, Ti and Cr ratios and decreased Nb, Rb, and Hf ones.

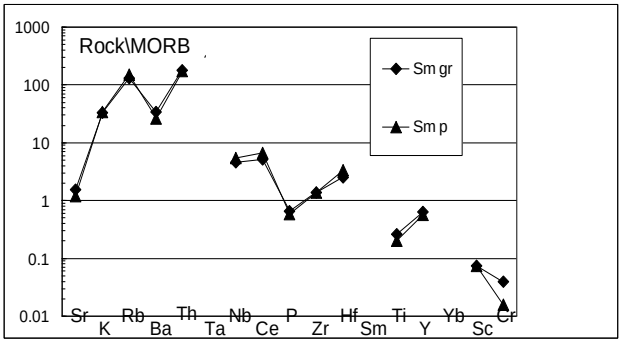

Fig. 7. Spider discrimination plot for the investigated rhyolites (Sm rg – grey rhyolites, Sm rp – pink rhyolites). Normalization values after Pearce (1982)

Table 1

Major element composition of the representative samples (major components)

Oxides wt.%	M1	M2	M3	1Mg*	2Mp*
SiO_2	75.59	74.79	57.76	73.89	74.60
TiO_2	0.21	0.24	0.58	0.24	0.22
Al_2O_3	12.17	13.00	19.52	13.63	13.68
Fe_2O_3	1.56	1.54	6.8	1.82	1.58
MnO	0.05	0.04	0.08	0.03	0.04
MgO	0.44	0.38	1.14	0.43	0.38
CaO	1.23	1.14	3.14	1.38	1.13
Na_2O	2.80	3.00	6.01	2.64	2.55
K_2O	4.63	4.97	2.52	4.90	5.10
P_2O_5	0.06	0.04	0.25	0.08	0.07
LOI	2.12	1.59	1.94	0.67	0.83
Total	100.86	100.73	99.74	99.70	100.16

Table 2

Major element composition of the representative samples (trace elements, n. d. – not determined)

Elements (in ppm)	1Mg	2Mp	M1	M2
Nb	16	19	n. d.	n. d.
Zr	123	124	n. d.	n. d.
Y	19	17	n. d.	n. d.
Sr	183	143	n. d.	n. d.
U	8	10	n. d.	n. d.
Rb	262	304	n. d.	n. d.
Th	36	35	n. d.	n. d.
Pb	35	36	102	15
Ga	17	16	n. d.	n. d.
Zn	30	30	46	57
Cu	6	3	27	10
Ni	2	2	28	49
Co	2	4	n. d.	n. d.
Cr	10	4	n. d.	n. d.
V	28	23	n. d.	n. d.
Ce	51	67	n. d.	n. d.
Nd	16	21	n. d.	n. d.
Ba	684	521	n. d.	n. d.
S	64	53	n. d.	n. d.
Hf	6	8	n. d.	n. d.
Sc	3	3	n. d.	n. d.
As	3	4	38	21
La	64	53	n. d.	n. d.

Application of the studied and similar rocks

Similar rock materials are used as building material, roof tails productian, house facing, decorative pavement production, etc. in the past in the area of the Rhodopes and other parts of Bulgaria. Hewn stone materials of thise type are used in the present too. They are popular in new houses building and touristic objects. Similar rocks of decorative quality as studied rhyolites are popular for production of material used in pavement production, house facing, as roof tails, interior and exterior decoration, etc.

Conclusions

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