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COMPOSITIONAL VARIATION OF BIOTITE FROM VARISCAN GRANITOIDS IN CENTRAL EUROPE: A STATISTICAL EVALUATION

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ABSTRACT

Major element compositions of biotites of the Central European Variscan plutonic rocks have been evaluated by discriminant function analyses. Four groups of biotites have been distinguished: Mg-, Fe-Al-, Fe-Mg- and Fe-Mn-biotites. Mg-biotite occurs in K-Mg-rich metaluminous calc-alkaline plutonic rock series (monzonitic suite) in the Central Bohemian Plutonic Complex (mostly in the southern part), in eastern part of the South Bohemian Plutonic Complex and a major part of the Tisia Terrane. Fe-Al-biotite occurs in the peraluminous plutonic rock series (granodioritic suite) in major (western) part of the South Bohemian Plutonic Complex, outer zone of the West Carpathian Plutonic Complex and in small aplitic dykes in the Tisia Terrane. Fe-Mg biotites occur in granitoids transitional between calc-alkaline and peraluminous rock series found mostly in the inner part of the West Carpathian Plutonic Complex of trondhjemitic (tonalitic) suite. Fe-Mn-biotite occurs in alkali-rich peraluminous, hypabyssal plutonic rocks (granodioritic suite) in the Pelsonian Terrane. The phlogopitic biotite crystallized at high temperature in a late- to postcollisional Variscan tectonic environment (350-340 Ma) where K-Mg-rich melt originated from the upper mantle and from the continental crust sources. The siderophyllitic Fe-biotite crystallized from Al-rich melt originating from the continental crust. Transitional Fe-Mg biotite probably crystallized from melts originating from different sources, e.g., oceanic and continental crusts (subduction related). The ages of these intrusions are uncertain. Fe-Mn-biotite showing alkaline character crystallized from a peraluminous melt at a late stage of crystal differentiation at low temperature in a postcollisional tectonic environment (280 Ma). The differing compositions of biotite represent different protoliths, melting conditions and different P, T, f_{O_2} and a_{H_2O} during crystallization. Based on the biotite geochemistry an early Mg-rich and a late Fe-rich plutonic series has been recognized in the Variscan Central European late- to postcollisional plutonic intrusions; a similar trend has been described in the Variscan External Crystalline Massive of the Alps and in Corsica.
Key words: biotite, major element composition, discriminant function analysis, Variscan granitoids, Central Europe

INTRODUCTION

Biotite is the one of the most important ferromagnesian constituents of the granitoids. From its composition we can get information about the protoliths, melting processes and P, T, f_{O_2} and a_{H_2O} conditions of the crystallization of the granitoid melt.

The analyzed and statistically evaluated biotite compositions derived from granitoids of the Moldanubian zone of the Variscan belt in the Central Bohemian Plutonic Complex, (CBP, Fig. 1), in the South Bohemian Plutonic Complex (SBP), in the Alpine collision zone (Western Carpathian Plutonic Complex, WCP) as well as behind it in the Tisia Terrane (TT) and the Pelsonian Terrane (PT). Three major host rock suites were identified according to the modal and CIPW norm compositions: a trondhjemitic (tonalitic), a granodioritic and a monzonitic (Fig. 2). The main target of the present publication was to estimate the conditions of crystallization of melts in these different suites indicative of different tectonic environments and to correlate them in the Variscan Central Europe.

METHODS

More than two hundred biotite analyses have been collected from the literature (Ďurkovičová, 1967; Fiala et al., 1976; Petrík, 1980; Minařík et al., 1988) or analysed by microprobe and ICP-AES methods (titration for FeO, gravimetric analysis for H_2O^- and H_2O^+) in the laboratories of the Department of Petrology and Geochemistry, Eötvös L. University and Geological Survey of Hungary. In order to check the titration method Mössbauer method used for identification of Fe^{2+}/Fe^{3+} ratio was carried out in the Department of Nuclear Chemistry, Eötvös L. University. Calculation of mineral formula was based on 22(O) in the case of microprobe analysis, 24 (O, OH) in the case of wet chemical analysis. We used for conclusions those analyses where Σ cations in X position range from 1.61–2.27 (average: 1.91) and Σ Y from 5.03–6.31 (average: 5.75). According to Foster (1960) X between 1.6–2.2 and Y more than 5 is acceptable in analyses of biotite. The biotite compositions were plotted on different diagrams (Nockolds, 1947; Engel and Engel, 1960; Foster, 1960; Wones and Eugster, 1965; Němec, 1972; Rossi and Chevremont, 1987; Abdel-Rahman, 1994) for presenting the classification of biotite, identification of coexisting minerals, determination of different magma types, giving information about the conditions of crystallization of magma and correlation of different plutons from different tectonic environments.

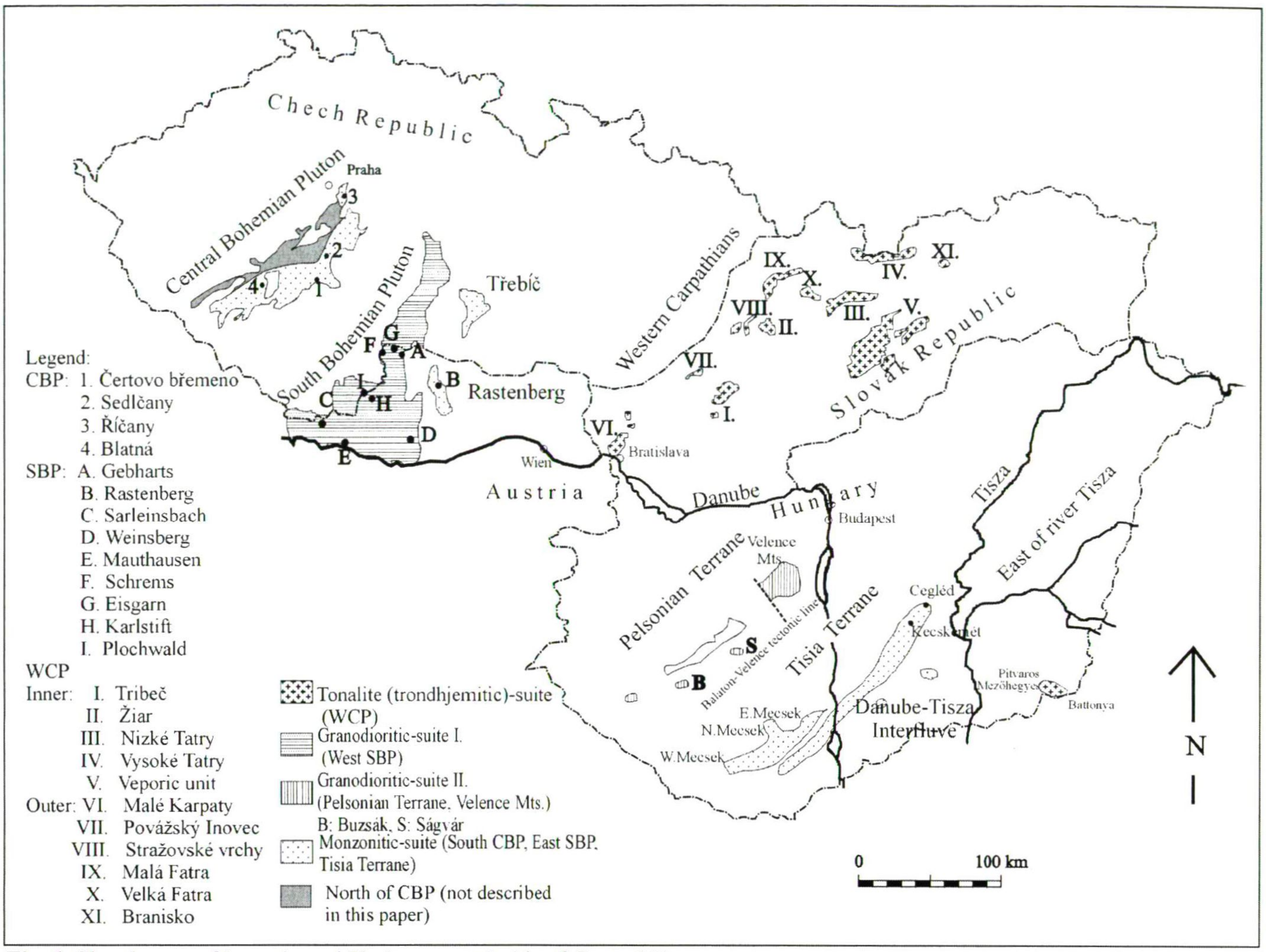

Fig. 1. Sketch map of investigated Variscan granitoids of Central Europe.

Biotite composition of Variscan granitoids from the studied areas

A) Central Bohemian Plutonic Complex (CBP)

The most common rock-types of the CBP are syenite, quartz syenite (durbachite), monzonite (Čertovo břemeno, Fig. 1), quartz monzonite, granodiorite, granite (Sedlčany, Blatná) and small amount of two micas granite (Říčany). Most rocks have metaluminous (A/CNK = 0.8±0.2) character and belong to the monzonitic suite (Fig. 2), representing I-type plutonic rocks. Biotites are characterized by high MgO-content (mg# = 50–76, average mg# = 61±10 (mg#=[Mg/(Mg+Fe)]x100, Fe = (Fe^{2+} + Fe^{3+})). Average phlogopite content is 57 mol% (calculated on the basis of Mg^{2+}% in the octahedral site) and siderophyllite content is very low (3 mol%). Biotites of the Čertovo břemeno type plutonic rocks are richest in MgO (mg# = 64) compared with the

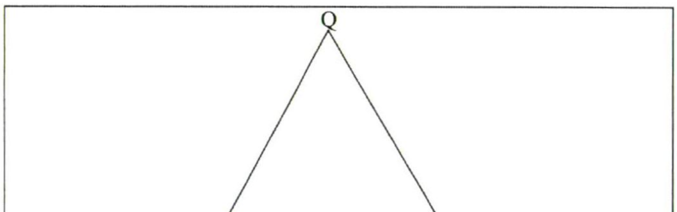

Fig. 2. QAP mesonorm diagram (Streckeisen, 1976) of Central European Variscan plutonic rocks (Tisia and Pelsonian Terranes, Central and South Bohemian Plutonic Complexes, South Alps and Western Carpathian Plutonic Complexes); 1. alkali felspar syenite, 2. syenite, 3. monzonite, 4. monzodiorite (monzogabbro), 5. diorite (gabbro), 6. quartz alkali feldspar syenite, 7. quartz syenite, 8. quartz monzonite, 9. quartz monzodiorite, 10. quartz diorite, 11. alkali feldspar granite, 12. syenogranite, 13. monzogranite, 14. granodiorite, 15. tonalite (trondhjemite). (after Lameyre et al., 1982 and Buda et al., 1997).

Sedlčany, Říčany (mg# = 59) and the Blatná (mg# = 52) types. They usually have low oxidation ratios ($Fe^{3+}/[Fe^{3+}+Fe^{2+}]$ = 0.07–0.17, average: 0.13) and mostly coexist with amphibole. The biotite crystallized from typical calc-alkaline magma (Table 1, Fig. 3A, Fig. 4A and Fig. 5A). The composition is very similar to the Mg-rich biotite of vaugnerites (mg# = 60-65; Sabatier 1991).

B) Tisia Terrane (TT)

1. Eastern Mecsek Mts. (Fig. 1)

Three main rock units occur: mafic enclaves or small bodies in granitoids, granitoids and microgranite dykes.

Two rock-types of mafic enclaves or small bodies can be distinguished by their different biotite compositions: (a.) monzonite, quartz monzonite with Mg-rich biotite ($FeO^*[FeO+Fe_2O_3 * 0.899]$ / MgO = 0.89, mg# = 61–74, average mg# = 67). (b.) quartz monzonite with higher Fe-bearing biotite (FeO*/MgO = 1.49; mg# = 51–63, average mg# = 56). Both contain amphibole and pyroxene. Average phlogopite content is 52 mol% with low siderophyllite content (5 mol%).

In microcline megacryst-bearing granitoids (quartz monzonite, granite) biotite has lower Mg-content (FeO*/MgO = 1.67, mg# = 51–58, average mg# = 53, phlogopite = 47 mol%, siderophyllite = 6 mol%). Amphibole is the most common coexistent mineral.

Mafic enclaves or small bodies as well as the hosting granitoids are metaluminous or slightly peraluminous (A/CNK = 0.94±0.2) and belong to the monzonitic suite (Fig. 2). They have I-type or I/S-type characters, which is supported by low $\delta^{18}O$ ratio (average biotite = 5.00‰, average whole rock = 8.84‰, Buda 1996) and by the presence of amphibole and chromite.

Biotite has high Al, Fe and low Mg-content (FeO*/MgO = 4.44; mg# = 35, phlogopite = 22 mol%, siderophyllite = 17 mol%) in the peraluminous (A/CNK = 1–1.1) microgranite dykes crosscutting the pluton.

In general the biotites are Mg-rich (mg# = 51–74, average mg# = 56±9), they show usually low oxidation state ($Fe^{3+}/Fe^{2+}+Fe^{3+}$ = 0.13–0.22, average = 0.19) and coexist with amphiboles. Both the enclaves and the host rocks have calc-alkaline character. The Mg-rich biotite composition of enclaves or small bodies is very similar to the Mg-biotite occurring in vaugnerite (French Massif Central), redwitzite (Voges, Schwarzwald) and durbachite (Central Bohemian Plutonic Complex). Fe-rich biotite with muscovite occurs only in peraluminous microgranite dykes (Table 2, 3, Fig. 3B, 4B, 5B).

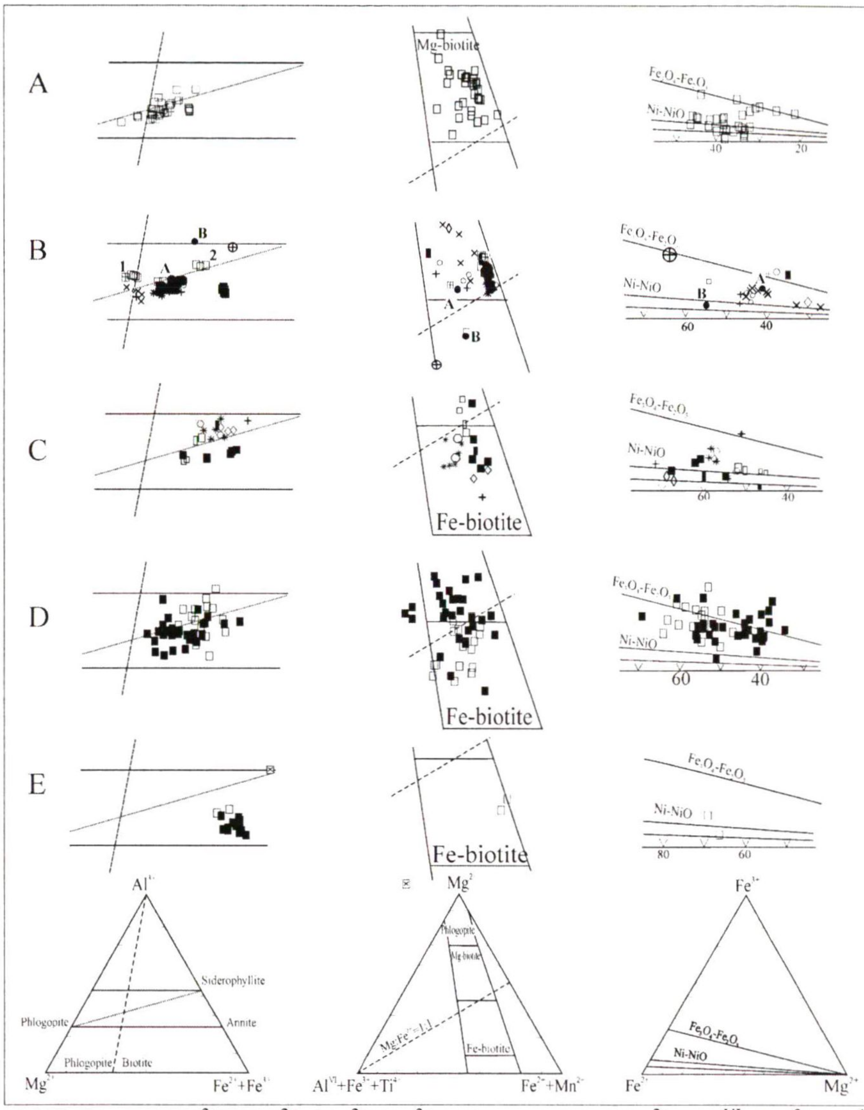

Fig. 3. Plots of Al^{3+}– Mg^{2+}– Fe^{2+}+Fe^{3+} (Němec, 1972), Mg^{2+}– Al^{VI}+Fe^{3+}+Ti^{4+} – Fe^{2+} +Mn^{2+} (Foster, 1960), Fe^{3+} – Fe^{2+} – Mg^{2+} (Wones and Eugster, 1965) of biotite composition of some Central European Variscan granitoids.

Legend for Figs. 3, 4 and 5:

(A) South part of Central Bohemian Plutonic Complex (Czech Rep.)=□

(B) Tisia Terrane (South Hungary). Mafic enclaves, microcline megacryst bearing granitoids and microgranites of Eastern Mecsek Mts.: O= Erdősmecske, ◊ = Feked, ▮= Véménd, x = Mórágy, + = Kismórágy, ⊕ = Kismórágy (microgranite), □ = Fazekasboda. Northern Mecsek Mts.: ■ = Szalatnak. Western Mecsek Mts.: ✱ = Almáskeresztúr. Duna-Tisza Interfluve: ●A = Kecskemét, ●B = Cegléd (granitoid). East of River Tisza: $□_1$ = Mezőhegyes, Battonya N, $□_2$ = Pitvaros, Battonya 64.

(C) South Bohemian Plutonic Complex (Austria): ■ = Gebharts, □ = Rastenberg, ■ = Sarleinsbach, ◊ = Weinsberg, □ = Mauthausen, O = Schrems, + = Plochwald (kingizite), x = Karlstift, ✱ = Eisgarn, ▯ = Weinsberg (granodiorite), ▮ = Plochwald.

(D) Western Carpathian Plutonic Complex (Slovakia): ■ = Inner belt (Tribeč, Žiar, Nizke Tatry, Vysoke Tatry, Veporic unit), □ = Outer belt (Malé Karpaty, Povážský Inovec, Strážovské vrchy, Malé Fatrá Velká Fatrá, Branisko).

(E) Pelsonian Terrane (Velence Mts., Hungary): □ = granite, ⊠ = microgranite, ■ = pegmatite.

2. Western Mecsek Mts.

The biotite composition (Almás-keresztúr: FeO*/MgO = 1.22; between;

mg# = 58–61) is similar to the biotite occurring in granitoids of the eastern Mecsek and it coexists with amphibole. The host rock is metaluminous (A/CNK = 0.91±0.2) calc-alkaline quartz monzodiorite.

3. Northern Mecsek Mts.

Biotite is rich in Fe (Szalatnak: FeO*/MgO = 3.25; mg# = 35, phlogopite = 43 mol%) and Ti (TiO_2 = 4.84 wt%) and depleted in Al (Al_2O_3 = 13.5 wt%, siderophyllite = 1mol %). The host rock is a metaluminous (A/CNK = 0.91±0.1) quartz monzonite and has a Fe-potassic calc-alkaline character according to the biotite composition.

4. Danube-Tisza Interfluve

Most of the host rock is granite with prevailing peraluminous character (A/CNK = 1.4±0.2).

Two types of biotite were distinguished:

a. Mg-biotite (FeO*/MgO = 1.67–1.75; mg# = 51) of medium oxidation state occurs with amphibole in calc-alkaline granite (Kecskemét). Their compositions are similar to the biotites of granitoids occurring in E-Mecsek Mts.

b. Fe-Al-rich biotite (FeO*/MgO = 2.38; mg# = 42) occurs with muscovite in peraluminous granite gneiss (Cegléd). It has a very low oxidation ratio. This locality is situated in the northeastern rim of the granitoid body, which is transitional into the surrounding gneisses.

5. East from River Tisza

Two major types of biotite can be distinguished:

a. Mg-biotite (FeO*/MgO = 0.83–1.50, mg# = 70) occurs with amphibole. The host rock is calc-alkaline granite and granodiorite (Mezőhegyes, Battonya North-2)

b. Fe-biotite (FeO*/MgO = 2.41–2.58, mg# = 41) occurs in peraluminous muscovite biotite granite (Pitvaros South-1 and Battonya-64, Table 4, Fig 3B, 4B, 5B)

C) South Bohemian Plutonic Complex (SBP)

According to the biotite composition two major populations can be identified:

a. Mg-biotite (FeO*/MgO = 1.59–1.66, mg# = 51, phlogopite = 48 mol%, sideropyllite = 1 mol%) occurs east part of SBP at Rastenberg in granodiorite, quartz syenite, quartz monzonite and in the small bodies of quartz monzodiorite at Gebharts with amphibole as a coexisting mineral. The oxidization level is low (Fe^{3+} = 0.22 per formula). The host rocks are calc-alkaline with I-type character ($\delta^{18}O$ = 7.4‰, Vellmer and Wedepohl 1994, metaluminous A/CNK = 0.9±0.1). They belong to granitoids of monzonitic suite (Fig. 2). These biotites are similar to the Mg-biotite of the CBP and the Tisia Terrane but with a slightly higher Fe- and lower Mg-content.

b. Fe-Al-biotite (FeO*/MgO = 2.14–5.42; mg# = 25–48, average mg# = 38±6, Al_2O_3 = 18.1±1wt%, phlogopite = 32 mol%, siderophyllite = 10 mol%.) occurs in the main part of the plutonic complex (Weinsberg, Mauthausen, Schrems, Eisgarn, Karlstift, Plochwald, Fig. 1). Oxidization is rather high (Fe^{3+} = 0.40 per formula). The main rock-type is peraluminous (A/CNK = 1.2±0.1) or transitional between peraluminous and calc-alkaline (Mauthausen-type) plutonic rock series, and belong to the granodioritic suite. They are mostly S-type ($\delta^{18}O$ = 10.1‰, Vellmer et al., op. cit. Table 5, Fig. 3C, 4C, 5C) granite. In quartz monzonite at Sarleinsbach biotite has high Fe (FeO*/MgO = 3.19, mg# = 36, phlogopite = 32 mol%,), Ti (TiO_2 = 5.42 wt%) and low Al-content (Al_2O_3 = 14.2 wt%, siderophyllite = 1 mol%) with an intermediate oxidization state (Fe^{3+} = 0.33 per formula). The host rock has a Fe-potassic calc-alkaline character according to the biotite composition.

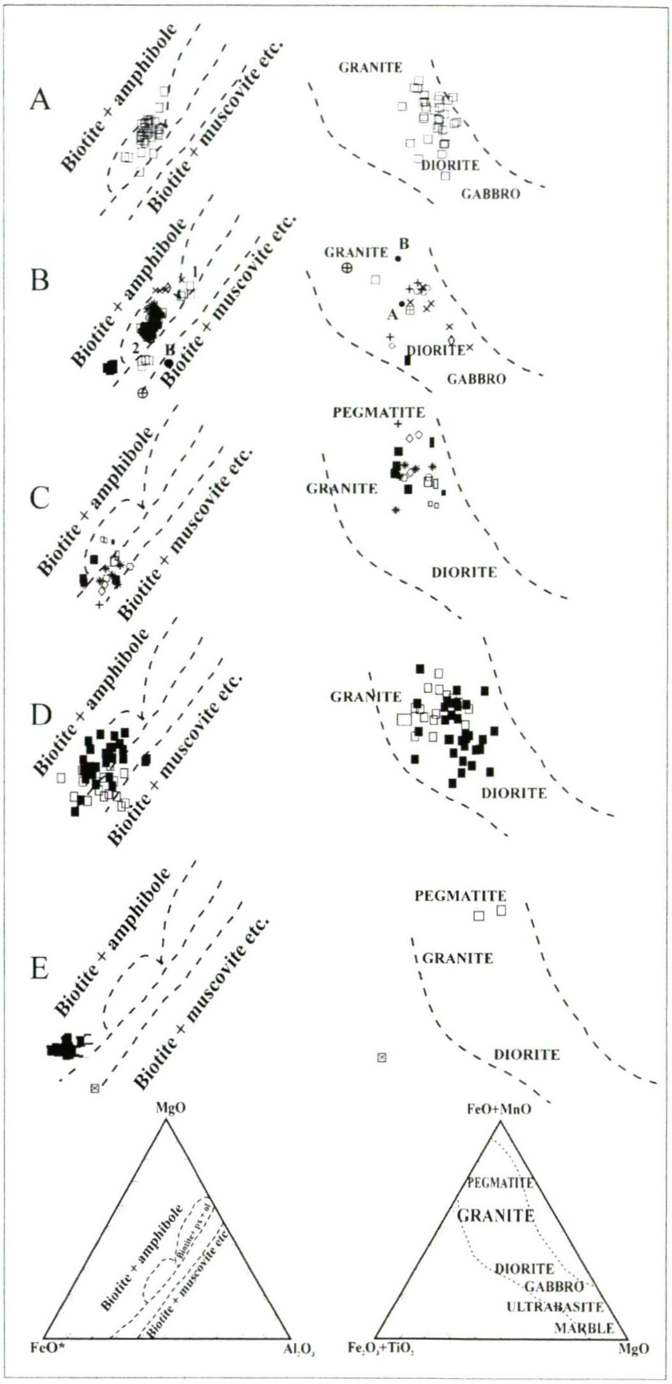

Fig. 4. Plots of MgO–FeO*(Fe_2O_3+FeO)–Al_2O_3 (Nockolds, 1947) and FeO+MnO–Fe_2O_3+TiO_2–MgO (Engel and Engel, 1960) of biotite composition of some Central European Variscan granitoids (legend is the same as Fig. 3).

D) Western Carpathian Plutonic Complex (WCP)

1. Inner-zone of WCP (Tribeč, Žiar, Nízke Tatry, Vysoke Tatry, Veporic unit, Fig. 1)

The biotites are mostly Mg-Fe-bearing (FeO^*/MgO = 2.06; mg# = 47±8, phlogopite = 42 mol%) with low Al-content (Al_2O_3 = 15.44±1.94 wt%, siderophyllite = 3 mol%) and highly oxidized (Fe^{3+} / (Fe^{3+}+Fe^{2+}) = 0.25, Fe^{3+} = 0.64 per formula). The coexisting mineral is mainly amphibole. The main rock-types are tonalite and granodiorite and more than 80% of biotite crystallized from a calc-alkaline magma source.

2. Outer-zone of WCP (Malé Karpaty, Považský Inovec, Strážovské vrchy, Malá Fatra, Velká Fatra, Branisko, Fig. 1)

Biotites are mostly Fe-Al biotites (FeO^*/MgO = 3.0; mg# = 38±5, phlogopite = 33 mol%) with high Al-content (Al_2O_3 = 16.48±2.17 wt%, siderophyllite = 7 mol%) with slightly lower oxidation ratio (Fe^{3+} / (Fe^{3+}+Fe^{2+}) = 0.23). Most of the biotite occurs alone but in some cases biotite together with muscovite can be also found. The main rock-type is granodiorite. Most of biotite crystallized from a peraluminous magma (Table 6, 7, Fig 3D, 4D, 5D).

The rocks of both zones are enriched in Na belong to the tonalitic (trondhjemitic) suite (Fig. 2) with slight peraluminous character (A/CNK = 1.1±0.2). They are I/S type granitoids.

E) Pelsonian Terrane (PT, Velence Mts.)

Three rock-types can be distinguished: 1. biotite granite (main intrusion) 2. microgranite dykes 3. pegmatite pods.

Fe-biotite (FeO^* = 30wt%, mg# = 26±5, phlogopite = 26 mol%) rich in annite molecule (annite = 63 mol%, siderophyllite = 3 mol%, Fig. 3E) is common in the biotite granite. According to FeO^*/MgO ratio they have alkaline characters except biotite in microgranite with peraluminous character (siderophyllite = 14 mol%, Table 8, Fig. 3E, 4E, 5E). Most of the biotites are highly oxidized (Fe^{3+} / (Fe^{3+}+Fe^{2+}) = 0.27) which could be partly of secondary origin. The granite is a S-type ($\delta^{18}O$ = 10.77‰ Buda op. cit.) with a peraluminous character (A/CNK = 1.1±0.1). They belong to the granodioritic-suite (Fig. 2) together with granitoids occurring along the Velence-Balaton tectonic lineament (Ságvár, Buzsák, Fig. 1).

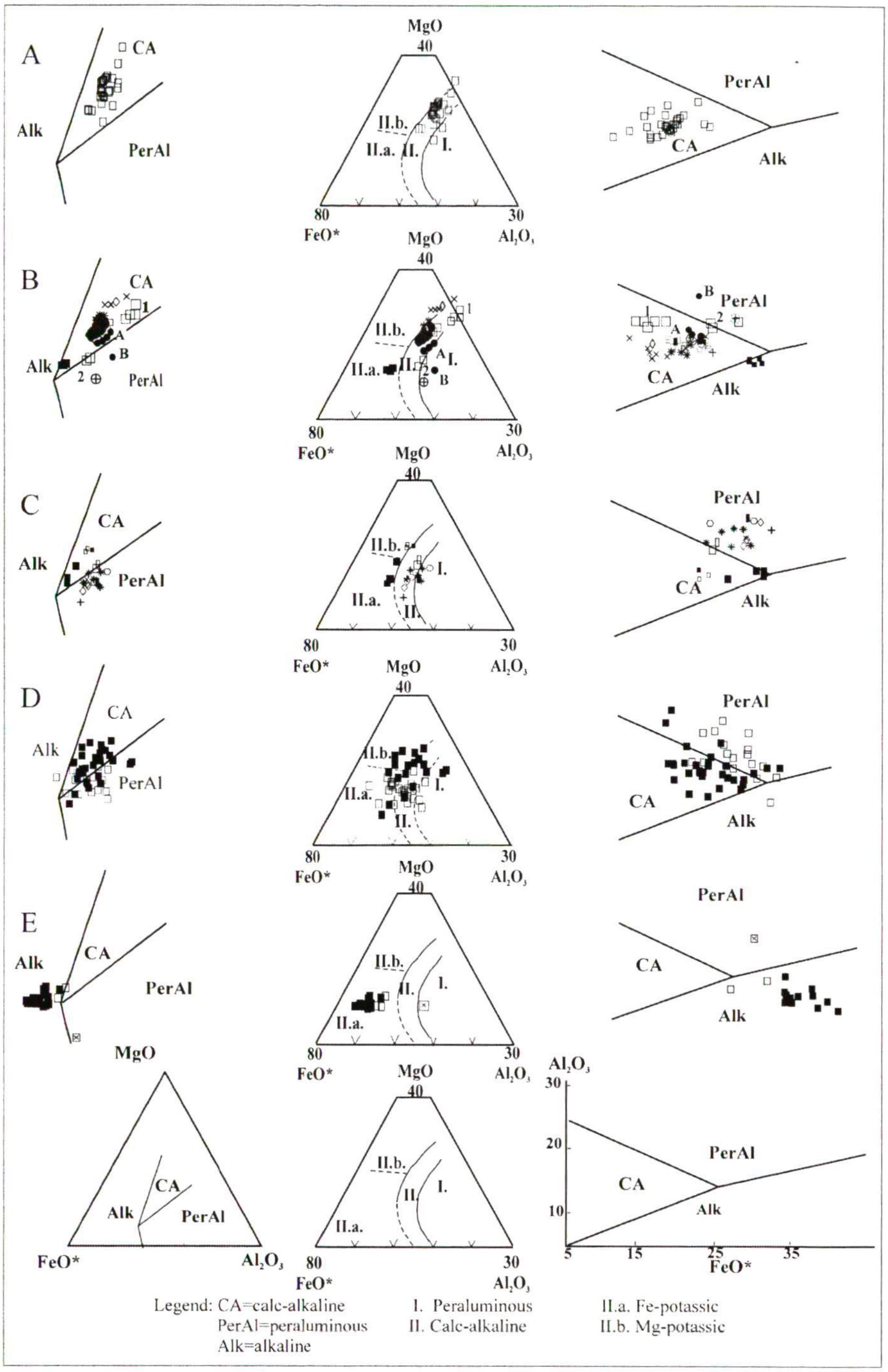

Fig. 5. Plots of MgO–FeO*–Al_2O_3 (Abdel-Rahman, 1994, Rossi and Chevremont, 1987) and Al_2O_3–FeO* (Abdel-Rahman, 1994) of biotite composition from some Central European Variscan granitoids (FeO*= FeO+Fe_2O_3, legend is the same as Fig. 3.).

DISCRIMINANT FUNCTION ANALYSES OF MAJOR CHEMICAL COMPONENTS OF BIOTITES

In the studied occurrences four chemically different groups of biotite have been distinguished (α = 0.5) based on six major chemical components (Si, Ti, Al, Fe, Mn, Mg) using discriminant fuction analyses with SPSS 10.0 for Windows package. The discriminant funtions are as follows:

$F1 = 0.410SiO_2 - 0.81TiO_2 - 0.290Al_2O_3 + 0.929FeO^* + 0.384MnO - 0.607MgO$,

$F2 = 0.582SiO_2 - 0.124TiO_2 - 0.856Al_2O_3 - 0.290FeO^* - 0.085MnO + 0.539MgO$,

$F3 = 0.485SiO_2 - 0.583TiO_2 + 0.356Al_2O_3 + 0.440FeO^* + 0.220MnO - 0.076MgO$ (Fig. 6).

According to the chemical composition of biotites the localities were grouped into four genetically different groups indicating similar plate tectonic environments within one group. According to the localities the discriminant functions are as follows:

F1 = $-0.347SiO_2-0.171TiO_2-0.179Al_2O_3+0.856FeO^*+0.495MnO-0.578MgO$,

F2 = $0.812SiO_2-0.201TiO_2-0.527Al_2O_3-0.334\ FeO^*+0.057MnO+0.480MgO$,

F3 = $-0.279SiO_2-0.430TiO_2-0.210Al_2O_3-0.164FeO^*-0.346MnO+0.647MgO$ (Fig. 7).

I. Mg-biotite (FeO*/MgO = 1.31, phlogopite = 52 mol%, siderophyllite = 3 mol%) occurs with amphibole, sometimes with pyroxene, as coexisting minerals. Biotites contain high Mg (Table 9, Fig. 6 and 8), Si and low Al, Fe, Mn with low oxidation ratio. The host rocks are syenite, quartz syenite (durbachite), monzonite, quartz monzonite and monzogranite deriving from a typical metaluminous, K-Mg rich calc-alkaline monzonitic suite magma. They occur in the southern part of the Central Bohemian Plutonic Complex (Fig. 7, 8), in the eastern part of South Bohemian Plutonic Complex and in the Tisia Terrane (90% of Mecsek Mts, Danube-Tisza Interfluves, and East of river Tisza) forming large bodies; the highest Mg-content biotites occur with amphibole+ pyroxene±chromite and form small bodies or enclaves in the large microcline megacryst-bearing quartz monzonitic or granitic complexes.

II.. Fe-Al biotite (FeO*/MgO = 2.8, phlogopite = 32 mol%, siderophyllite = 10 mol%) occurs alone or with muscovite containing high Al and Fe and low Mg and Si (Fig. 6, 8). The high Al_2O_3 content is the significant difference from the previous group. They occur mostly in the main part of the South Bohemian Plutonic Complex, the Western Carpathian Plutonic Complex mostly in the outer-zone (Fig. 7) and few small occurrences in the Tisia Terrane (microgranite from the Mecsek Mts, Danube-Tisza Interfluves: Cegléd, the East of river Tisza: Battonya, Pitvaros) and the Pelsonian Terrane (microgranite in the Velence Mts.).

III. Fe-Mg biotite (FeO*/MgO = 2.5, phlogopite = 42 mol%, siderophyllite = 7 mol%, Fig. 6, 8.) transitional between the first and second groups (Mg- and Fe-Al biotite, Table 9, Fig. 6). Most biotite in the inner part of WCP (Fig. 7), North of Mecsek Mts. (Szalatnak) and Sarleinsbach in SBP can be classified into this group. The two later ones are enriched in Fe (annite = 56 mol%) too.

IV. Fe-Mn biotite enriched in annite molecule (FeO*/MgO = 4.8, annite = 63 mol%,), contains high Fe, Mn (Table 9, Fig. 6, 8) and with low Mg, Al. They occur only in the Pelsonian Terrane in the Velence Mts.

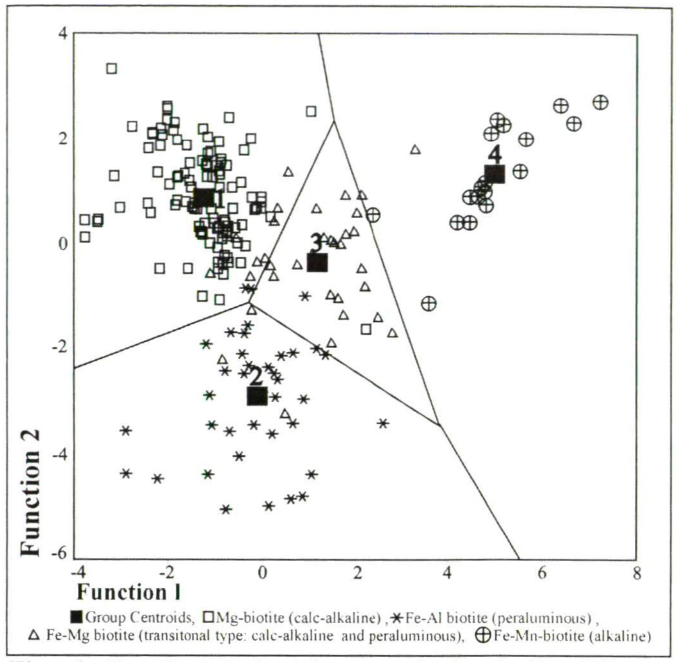

Fig. 6. Function territorial map of chemically different biotites occurring in the Variscan granitoids of Central Europe (Variables: SiO_2, TiO_2, Al_2O_3, FeO*, MnO, MgO).

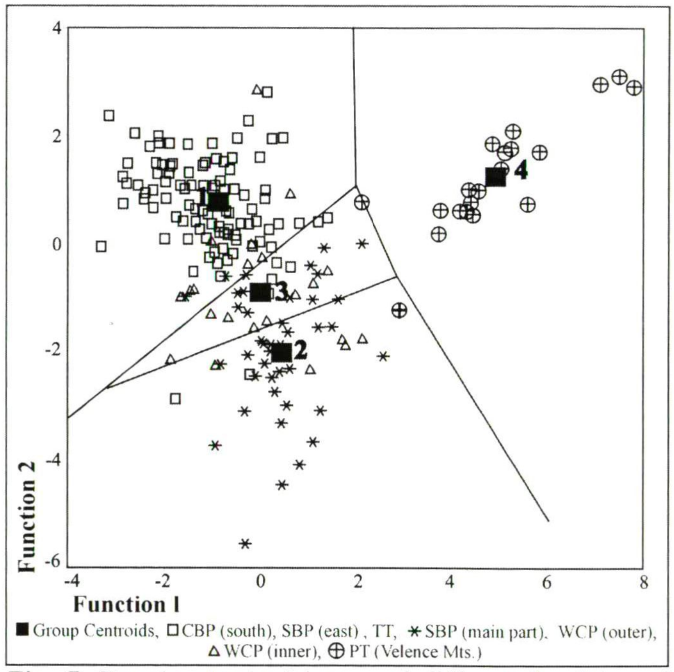

Fig. 7. Function territorial map of different localities of biotites occurring in the Variscan granitoids of Central Europe (Variables: SiO_2, TiO_2, Al_2O_3, FeO*, MnO, MgO).

Table 9. Average major components of biotites grouped based on the compositions and localities by statistical discriminant function analyses.

	I. group		II. group		III. group		IV. group	
	Mg-biotite (n=109)	Localities (n=116)	Fe-Al biotite (n=39)	Localities (n=39)	Fe-Mg biotite (n=37)	Localities (n=29)	Fe-Mn biotite (n=18)	Localities (n=19)
SiO_2	37.7±0.8	37.5±0.9	35.2±1.5	34.8±1.3	35.1±0.9	35.7±1.3	35.8±0.7	35.8±0.8
TiO_2	2.7±0.8	2.9±0.9	2.9±0.4	3.2±0.9	3.6±1.0	2.8±0.5	1.8±1.6	1.9±1.5
Al_2O_3	14.8±0.9	14.8±1.1	17.9±1.4	16.9±2.1	14.5±1.2	15.4±1.9	12.9±0.7	13.2±1.3
FeO*	17.1±2.3	17.5±2.7	21.9±2.1	22.9±1.9	22.8±2.5	20.9±2.7	30.0±1.7	29.6±2.0
MnO	0.24±0.08	0.25±0.09	0.35±0.2	0.32±0.14	0.32±0.15	0.30±0.13	0.6±0.1	0.6±0.2
MgO	13.1±2.0	12.7±2.4	7.9±1.9	7.9±1.4	9.3±2.1	10.4±2.3	6.2±0.6	5.9±1.3
K_2O	9.3±0.6	9.2±0.6	8.6±0.7	8.5±0.6	8.4±0.9	8.5±1.0	8.6±0.6	8.5±0.6

I. group. CBP (southern part), SBP (eastern part), TT; II. group. SBP (main part), WCP (outer part); III. group. WCP (inner part); IV. group. PT (Velence Mts.).

Correlation of major chemical components of biotite

The Mg-biotite has high Si whereas the Fe-Al-biotite has lower Si contents. Substitution of Mg by Fe in the octahedral site is obvious ($r_{Mg\text{-}Fe} = -0.89$). The negative correlation of K with Fe^{3+} and H_2O is probably due to the secondary chloritization.

Phlogopite component rich biotites (Mg^{2+} = 3.17–2.63 per formula) contain rather low Al in the tetrahedral (2.35) as well as in the octahedral sites (0.27). Siderophyllite molecule rich Fe-Al-biotite is rich in Al in the tetrahedral (2.68) as well as in the octahedral sites (0.48). The annite molecules rich Fe-Mn biotite enriched in Si (5.73) and the tetrahedral site contains low contents of Al (2.27) and Fe (3.98) prevails in the octahedral site.

The Mg, Si rich and Al poor biotite crystallized mostly from I-type, calc-alkaline magma where the role of the Al was limited. The Fe, Al-rich, Si-poor biotite crystallized from peraluminous melts originating mostly from the partially melted Al-rich continental crust (S-type granitoids). These biotites contain larger amounts of Al and low Si in the tetrahedral site and the residual melt is relatively enriched in Si.

Fe-biotite crystallized at low temperature from Si-rich residual magma resulting in a Si-enrichment in biotite.

Discussion and Conclusion

The investigated late- and post-collision Variscan granitoids (340–280 Ma) of Central Europe can be classified into four groups according to the their biotite compositions: Mg-biotite crystallized from calc-alkaline magma, Fe-Al-biotite crystallized from peraluminous magma, transitional Fe-Mg-biotite originated from mixed sources between calc-alkaline and peraluminous magmas and Fe-Mn-annite molecule-rich biotite crystallized at the late stage of differentiation path from alkaline enriched originally peraluminous magma.

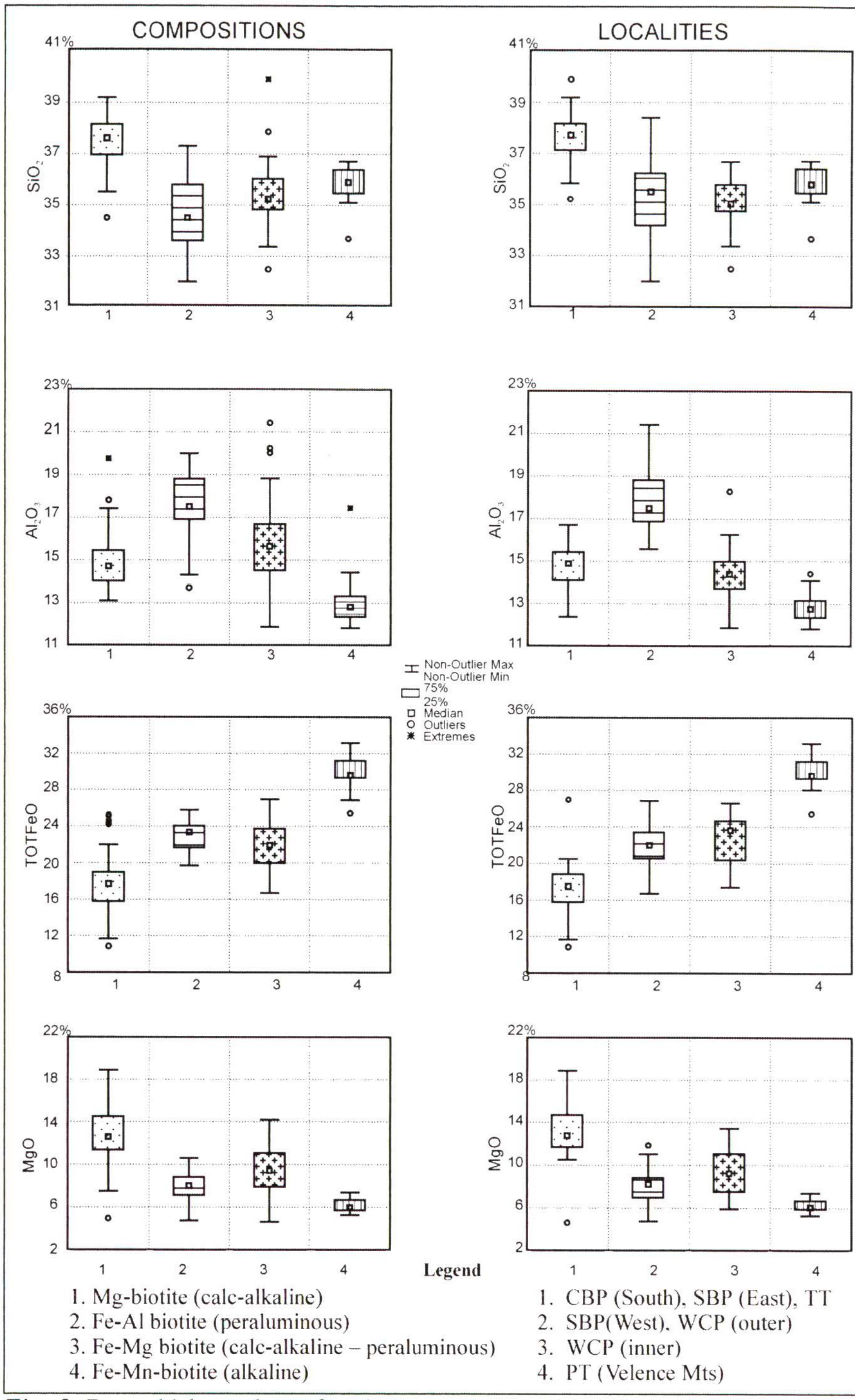

Fig. 8. Box-whiskers plots of major components of biotite grouped according to compositions and occurrences.

Mg-biotite occurs in metaluminous Mg-K-rich monzonitic suite, I-type granitoids accompanied by lamprophyre derived durbachite-vaugnerite small bodies and enclaves (Buda et al., 2000, localities: southern part of CBP, eastern part of SBP and in TT). These rocks derived from at least two different melt sources. The basic mafic small bodies and enclaves contain phlogopitic biotite originating from subcontinental incompatible elements enriched upper mantle and the hosting granitoid, with a slightly higher amount of Fe, crystallized from a melt containing more crustal contribution. Phlogopitic biotite crystallized above 800 °C under low oxygen fugacity (around Ni-NiO buffer)

Fe-Al-rich biotite occurring in S-type, granodioritic suite plutonic rocks crystallized from a melt originating from partially melted continental crust (localities: main part of the SBP, outer zone of the WCP and some small occurrences of the TT).

In the case of the transitional type Mg-Fe-biotite, occurring in the trondhjemitic-suite, I/S-type granitoids, the role of the continental and oceanic crusts were variable, e.g. in the WCP the amount of continental crustal melt increased from inner part to the outer.

According to Petrík (1980) the minimum crystallization temperature of biotite in the inner part was 775 °C (Tribeč) and the outer one was 740 °C (Malé Karpaty).

The annite molecule-rich biotite crystallized at around 680°C at 200 MPa (Buda, 1985), at the late stage of crystal differentiation in a hypabyssal, peraluminous, granodioritic - suite, S-type pluton, in the Velence Mts. (PT). The P and T estimations are based on the stability curve of biotite using data of Wones and Eugster (1965), Huebner and Sato (1970) and Wones (1972).

These results correspond with Rutherford's (1973) experiments according to his results Fe-Al biotites are more stable at high temperature than annite.

Decreasing temperature with increasing Fe-content of biotite results in a series from Mg-K rich to Fe-rich granitoids in Central Europe. Similar Variscan plutonic suite was described by Debon and Lemmet (1999) in the External Crystalline Massifs of the Alps. They have distinguished a high magnesian suite (330–340 Ma) and magnesian-ferriferous and ferriferous suites (295–305 Ma). Mg-rich plutons contain vaugnerite or durbachite enclaves rich in both compatible and incompatible elements (e.g., Mg and K) comparable with lamproitic or lamprophyric rocks.

Plutonic rocks of the K-Mg-rich monzonitic suite most probably formed a significant part of the Moldanubian zone in the Variscan Central Europe: southern part of the CBP, eastern part of the SBP, TT having similar protolith, melting and crystallization history. TT was disconnected later on from the Moldanubian zone (Buda, 1998).

The annite molecule-rich biotite-bearing granitoids of the Pelsonian Terrane have different protoliths, melting and crystallization conditions from the previous plutons and showing similar origin with granitoids occurring in the Southern Alps (Buda, op cit.).

The origin of so-called Fe-potassic calc-alkaline-type biotite with high Fe, Ti and low Al contents found at Sarleinsbach (Austria) or Szalatnak (Hungary) is obscure probably because they are also of hybrid origin from an older re-equilibrated mangeritic source and from a younger granitic melt (Klötzli et al., 2001).

Plutonic rocks without thermal contact like the TT, southern part of the CBP, eastern part of the SBP contain low oxidized biotite with ilmenite (Fig. 9) where the deep seated initial melt was probably water saturated.

Biotites occurring in intrusive granitoids are mostly highly oxidized, (WCP, Sierra Nevada, PT) containing magnetite as accessory minerals. The high temperature initial melt of intrusive granitoids results in magnetite crystallization (Dodge et al., 1969; Ishihara, 1977; Buda, 1990) and at the late stage Fe-biotite crystallized from volatile-rich melt. Biotite was oxidized due to the dissociation of water and migration of hydrogen from the system.

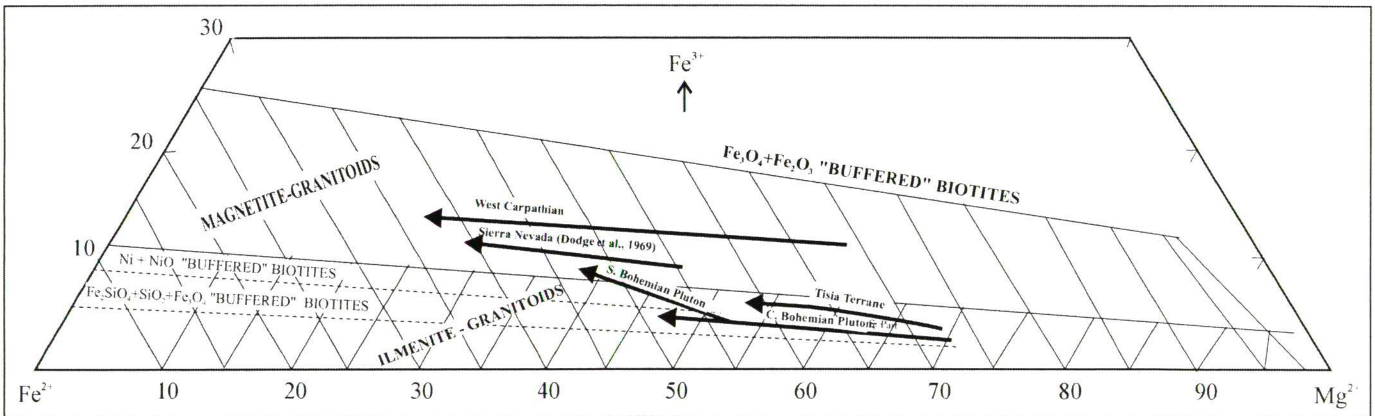

Fig. 9. Compositions of biotites from granitoids projected onto annite - phlogopite - KFe $^{3+}$ $AlSi_3O_{12}(H^-)$ ternary system (Wones and Eugster, 1965).

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Table 1. Biotite compositions of granitoids of the Central Bohemian Plutonic Complex (Czech Republic)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
SiO_2	38,59	38.76	38.78	38,65	37,83	37,01	37.84	37.94	37.48	37.76	37,89	36.80	35,38	36,51	37.74	37,35
TiO_2	3,50	3,11	3,13	3,67	4,10	3,96	3,25	4,00	3,83	2.88	3,23	3,13	3.40	1,62	1,50	1,55
Al_2O_3	13.67	14.23	13.08	13.45	13.43	13.76	14.46	13.48	13.84	15.32	14.36	15.39	13.80	16.69	15.82	15.33
Fe_2O_3	1,67	0,69	0,88	1,73	1,17	2.01	1,05	1,23	1.11	0,17	0,35	2.44	3.30	5,25	3,73	4,27
FeO	12.77	13.42	13,51	13.47	13.24	14.50	14.42	14.54	14.80	15.61	15.49	15.48	12.54	14.20	11.13	10.10
MnO	0,19	0,18	0,19	0,18	0,18	0,19	0.26	0.20	0,20	0,22	0,25	0.28	0,22	0,29	0,21	0,22
MgO	15.97	15.46	15,56	14.99	15.50	15.95	14.74	14.91	15.01	14.51	14.45	12.70	14.77	10.57	14.73	15,05
CaO	0,02	0.10	1.63	0,82	0,17	0,13	0.53	0,23	0.10	0,09	0,09	0.18	1,86	0,27	0,20	0,27
Na_2O	0,16	0,15	0,17	0,15	0,16	0,15	0,21	0,14	0,20	0,16	0,17	0,18	0,69	0,46	0,47	0,58
K_2O	9.56	9.49	8.92	9.01	9.43	8.43	8.71	8.49	9.43	9.21	9.74	9.62	7,82	8,11	8,19	8,12
H_2O^+	2.71	3.17	3,20	2,69	2.62	3,83	3.31	3.64	2,61	3,37	3,01	3,02	4,33	3,74	3.53	4,20
F	0,65	0,59	0,50	0.52	0.57	0.55	0.56	0.58	0,67	0.52	0.65	0,89	0,42	0,19	0,39	0,47
Total	99,46	99.35	99,55	99,33	98,40	100,47	99,34	99,38	99,28	99,82	99,68	100,11	98,53	97,90	97,64	97,51
Numbers of ions on the basis of 24(O,OH)																
Si	5,807	5,801	5,813	5,839	5,775	5,485	5,682	5,672	5.713	5,657	5.731	5.577	5.326	5.565	5.674	5.575
Ti	0,396	0,350	0,353	0,417	0,471	0,441	0,367	0,450	0,439	0,324	0,367	0,357	0,385	0,186	0,169	0,174
Al	2,424	2.510	2,311	2,395	2,416	2,403	2,559	2,375	2,487	2.705	2,560	2,749	2,448	2,998	2,803	2,697
Fe3+	0,189	0,078	0,099	0,197	0,134	0,224	0,119	0,138	0,127	0,019	0,040	0,278	0,374	0,602	0,422	0,479
Fe2+	1,607	1,680	1,694	1,702	1,690	1,797	1,811	1,818	1,887	1,956	1,959	1,962	1,579	1,810	1,399	1,261
Mn	0,024	0,023	0,024	0,023	0,023	0,024	0.033	0,025	0,026	0,028	0,032	0,036	0,028	0,037	0,027	0,028
Mg	3,582	3.449	3.477	3,375	3.527	3,523	3,299	3,323	3.410	3,240	3,258	2,869	3,314	2,401	3,301	3,348
Ca	0,030	0,016	0,262	0,133	0,028	0,021	0,085	0,037	0,016	0,014	0,014	0,029	0,300	0,044	0,032	0,043
Na	0,047	0,043	0,049	0,044	0,047	0,043	0,061	0,041	0,059	0,046	0,050	0,053	0,201	0,136	0,137	0,168
K	1,835	1,812	1,706	1,736	1,836	1,594	1,668	1,619	1,834	1,760	1,879	1,860	1,502	1,577	1,571	1,546
OH	2.720	3,164	3,200	2,711	2,668	3,786	3,316	3,630	2,654	3,368	3,037	3,053	4,348	3,803	3,540	4,181
F	0,309	0,279	0,237	0,248	0,275	0,258	0,266	0,274	0,323	0,246	0,311	0,426	0,200	0,091	0,185	0,222
ΣCAT	15.915	15.761	15.787	15.859	15.949	15.556	15.685	15.498	15.998	15.751	15.891	15.769	15.456	15.357	15.535	15.318
mg	69.030	67.260	67.240	66.490	67.610	66.220	64.560	64.640	64.390	62.360	62.450	59.390	67.730	57.020	70.230	72.650
Al4	2.193	2.199	2.187	2.161	2.225	2.403	2.318	2.328	2.287	2.343	2.269	2.423	2.448	2.435	2.326	2.425
Al6	0.232	0.311	0.124	0.233	0.192	-	0.242	0.048	0.200	0.363	0.291	0.326	-	0.564	0.477	0.271
Fe3T	-	-	-	-	-	0.112	-	-	-	-	-	-	0.226	-	-	-
Z site	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
Y site	6.030	5.889	5.771	5.946	6.037	5.898	5.870	5.802	6.089	5.930	5.948	5.827	5.453	5.601	5.795	5.561
X site	1.885	1.871	2.017	1.913	1.911	1.657	1.815	1.696	1.909	1.821	1.944	1.942	2.003	1.757	1.740	1.757

	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
SiO_2	38,36	39,18	38,70	37,82	37,56	37,54	36,90	37,95	38,63	37,50	37,86	38,80	36,10	37.30	35,80
TiO_2	2.93	2.48	3.28	3.16	3.26	3.26	3.16	3.10	3.27	3.33	2.86	3.28	3.20	2.73	3.45
Al_2O_3	13.72	13.17	15.20	13.81	13.77	14,35	15.13	14.00	14,32	14.80	16.23	14.50	14,20	14,50	14.40
Fe_2O_3	3,96	3,75	1,75	1,23	1,33	2.01	0,95	1,17	2.63	2.52	2,22	4,84	2.75	2,78	1,81
FeO	8.91	7.48	15.90	15.38	15.10	15.39	15.95	15.70	13.43	14.43	14.00	11.80	17.60	17,00	18.40
MnO	0,18	0,12	0,24	0,33	0,27	0,28	0,37	0,28	0.24	0,24	0,32	0,25	0,36	0,22	0,32
MgO	16.89	18.85	12.60	14.49	14.18	14.48	13.67	13.66	12.73	13.35	12.03	13.30	12.10	12.00	12.30
CaO	0,11	0,93	0,29	0,21	0,13	0,06	0,25	0,23	0,27	0,04	0,01	0,38	0,29	0,91	0,72
Na_2O	0.12	0,23	0,11	0,15	0,16	0,15	0,18	0,16	0,15	0,14	0,15	0,08	0,11	0,23	0,13
K_2O	8.23	8,40	8,40	9,00	9,45	9,36	8,70	9,47	9,59	9,47	9,62	9,68	9,06	9,00	7,94
H_2O^+	2,95	3,19	3,68	3,08	3,19	2,94	3,55	3,10	2,65	2,44	2,79	2,01	3,37	3,03	4,41
F	0,28	0,41	0,00	0,68	0,70	0,68	0,71	0,67	1,81	1,66	1,80	0,00	0,00	0,00	0,00
Total	96,64	98,19	100,15	99,34	99,10	100,50	99,52	99,49	99,72	99,92	99,89	98,92	99,14	99,70	99,68
Numbers of ions on the basis of 24(O,OH)															
Si	5,812	5,807	5,751	5,731	5,708	5,653	5,557	5,757	5,826	5,690	5,694	5,935	5,564	5,709	5,405
Ti	0,334	0,276	0,366	0,360	0,373	0,369	0,358	0,354	0,371	0,380	0,323	0,377	0,371	0,314	0,392
Al	2,450	2,301	2,662	2,466	2,466	2,547	2,686	2,503	2,546	2,647	2,877	2,614	2,579	2,615	2,563
Fe3+	0,451	0,418	0,196	0,140	0,152	0,228	0,108	0,133	0,298	0,288	0,251	0,557	0,319	0,320	0,206
Fe2+	1,129	0,927	1,976	1,949	1,919	1,938	2,009	1,992	1,694	1,831	1,761	1,510	2,269	2,176	2,323
Mn	0,023	0,015	0,030	0,042	0,035	0,036	0,047	0,036	0,031	0,031	0,041	0,032	0,047	0,029	0,041
Mg	3,814	4,164	2,791	3,273	3,212	3,250	3,069	3,089	2,862	3,019	2,697	3,032	2,780	2,737	2,768
Ca	0,018	0,148	0,046	0,034	0,021	0,010	0,040	0,037	0,044	0,007	0,002	0,062	0,048	0,149	0,116
Na	0,035	0,066	0,032	0,044	0,047	0,044	0,052	0,047	0,044	0,041	0,044	0,024	0,033	0,068	0,038
K	1,591	1,588	1,592	1,740	1,832	1,798	1,671	1,833	1,845	1,833	1,846	1,889	1,781	1,757	1,529
OH	2,981	3,154	3,648	3,113	3,234	2,953	3,566	3,137	2,666	2,470	2,799	2,051	3,465	3,093	4,442
F	0,134	0,192	-	0,326	0,336	0,324	0,338	0,321	0,863	0,797	0,856	-	-	-	-
ΣCAT	15.658	15.711	15.441	15.778	15.764	15.872	15.597	15.781	15.560	15.766	15.535	16.032	15.790	15.875	15.381
mg	77.160	81.790	58.540	62.680	62.600	62.640	60.430	60.790	62.810	62.250	60.500	66.770	55.060	55.710	54.370
Al4	2.188	2.193	2.249	2.269	2.292	2.347	2.443	2.243	2.174	2.310	2.306	2.065	2.436	2.291	2.563
Al6	0.262	0.108	0.413	0.197	0.174	0.200	0.243	0.260	0.372	0.337	0.571	0.549	0.143	0.324	-
Fe3T	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.032
Z site	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
Y site	6.014	5.909	5.772	5.961	5.864	6.021	5.833	5.864	5.627	5.886	5.644	6.058	5.928	5.900	5.698
X site	1.644	1.802	1.670	1.817	1.900	1.851	1.764	1.917	1.933	1.881	1.891	1.975	1.862	1.974	1.684

1-19. Čertovo břemeno type (melanocratic amphibole biotite syenite, quartz syenite, durbachite, monzonite); **20-24.** Sedlčany type (quartz monzonite, biotite granite); **25-28.** Ričany type (biotite±muscovite granite); **29-31.** Blatná type (granodiorite and granite).
1. W of Milevsko; **2.** Milevsko core sample; **3.** S of Sedlčany; **4.** Velká mine W of Milevsko; **5.** Vepice quarry SW of Sedlčany; **6.** Pechova Lhota NW of Milevsko; **7.** Jesenice quarry SSE of Sedlčany; **8.** Kojetín SW of Sedlčany; **9.** Chlum near Jistebnice; **10.** Votice quarry; **11.** Nedrahovice SE of Sedlčany; **12.** Milevsko quarry; **13.** Vepice quarry near Kovářov; **14.** Beztahov, near Votice quarry; **15.** Beztahov near Votice quarry; **16.** Same locality; **17.** Kamenné Doly, near Pisek, dark facies; **18.** Kamenné Doly, near Pisek, light facies; **19.** Milevsko; **20.** Bořena Hora quarry E of Sedlčany; **21.** Vapenice quarry SSW of Sedlčany; **22.** 2 km SE of Kosova Hora, E of Sedlčany; **23.** SE of Kosova Hora; **24.** Vrchotovy Janovice quarry ENE of Sedlčany; **25.** Kozojedy quarry E of Řičany; **26.** NW of Žernovka, E of Řičany; **27.** Srbín quarry ESE of Řičany; **28.** Žernovka, Řičany; **29.** Hudčice quarry, Blatná type; **30.** Blatná quarry; **31.** Kozlí quarry Blatná type.
All wet chemical analyses
References: Fiala et al. (1976) 1-12. 20-27; Minařík et al. (1988); 13-16; Unpublished: 19, 28-31.
$mg\# = [Mg^{2+}/(Fe^{2+}+Mg^{2+})]\cdot 100$; $Y = Ti^{4+}+Fe^{3+}+Fe^{2+}+Mn^{2+}+Al^{VI}$; $X = Ca^{2+}+Na^{+}+K^{+}$

Table 2. Tisia Terrane I.: biotite compositions of mafic enclaves from Mecsek Mts.

East Mecsek Mts.

	Enclaves I.											Enclaves II.				
	1	2	3	4	5	6	7*	8*	9*	10*	11*	12	13	14	15	16
SiO_2	38.32	38.00	38.92	38.70	38.54	38.16	37.63	38.63	35.82	37.73	37.22	38.05	37.17	37.99	37.82	38.03
TiO_2	2.10	1.72	1.95	1.69	2.70	1.71	3.16	2.70	1.91	3.50	2.08	3.31	3.20	3.25	2.76	3.21
Al_2O_3	14.01	14.16	13.75	14.38	13.48	13.79	13.74	15.61	15.27	14.88	15.21	14.01	13.94	14.05	13.68	13.74
Fe_2O_3	-	-	-	-	-	-	2.20	1.71	3.77	2.24	7.40	-	-	-	-	-
FeO	14.14	14.33	14.50	14.00	14.51	14.90	13.71	10.94	15.84	12.31	9.99	17.86	17.63	17.24	17.54	17.80
MnO	0.04	0.00	0.08	0.08	0.13	0.00	0.23	0.17	0.37	0.17	0.21	0.24	0.23	0.25	0.25	0.32
MgO	15.62	16.09	15.83	15.95	15.46	15.62	16.45	17.56	14.01	16.93	13.76	12.56	12.64	12.72	12.52	12.43
CaO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.43	0.04	0.03	0.04	0.09	0.09
Na_2O	0.10	0.07	0.08	0.09	0.11	0.07	0.15	0.20	0.14	0.15	0.15	0.09	0.09	0.09	0.10	0.08
K_2O	9.96	9.73	9.73	9.27	9.65	8.59	9.52	9.15	8.05	9.00	8.00	9.75	9.82	9.65	9.64	9.78
H_2O^+	-	-	-	-	-	-	2.55	2.72	4.22	2.69	4.78	-	-	-	-	-
Cl	-	-	-	-	-	-	0.00	0.00	0.00	0.00	0.00	-	-	-	-	-
Total	94.29	94.10	94.84	94.16	94.58	92.84	99.34	99.39	99.42	99.60	99.23	95.91	94.75	95.28	94.40	95.48
Numbers of ions on the basis of 22(O) or 24 (O.OH)																
	22 (O)						**24(O,OH)**					**22(O)**				
Si	5.768	5.732	5.819	5.795	5.787	5.807	5.727	5.744	5.387	5.656	5.463	5.731	5.680	5.741	5.784	5.759
Ti	0.238	0.195	0.219	0.190	0.305	0.196	0.362	0.302	0.216	0.394	0.230	0.375	0.368	0.369	0.317	0.366
Al	2.485	2.517	2.423	2.538	2.385	2.473	2.465	2.735	2.707	2.629	2.631	2.487	2.511	2.502	2.466	2.452
Fe^{3+}	-	-	-	-	-	-	0.252	0.191	0.427	0.253	0.817	-	-	-	-	-
Fe^{2+}	1.780	1.808	1.813	1.753	1.822	1.896	1.745	1.360	1.992	1.543	1.226	2.250	2.253	2.179	2.243	2.254
Mn	0.050	-	0.010	0.010	0.016	-	0.030	0.021	0.047	0.022	0.026	0.031	0.030	0.032	0.032	0.041
Mg	3.504	3.617	3.527	3.560	3.460	3.543	3.732	3.891	3.141	3.783	3.010	2.820	2.879	2.865	2.854	2.806
Ca	-	-	-	-	-	-	-	-	0.003	-	0.068	0.006	0.005	0.006	0.015	0.015
Na	0.029	0.020	0.023	0.026	0.032	0.021	0.044	0.058	0.041	0.044	0.043	0.026	0.027	0.026	0.030	0.023
K	1.912	1.872	1.856	1.771	1.848	1.668	1.848	1.735	1.544	1.721	1.498	1.873	1.914	1.860	1.880	1.889
OH	-	-	-	-	-	-	2.589	2.698	4.234	2.690	4.680	-	-	-	-	-
Cl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ΣCAT	15.722	15.761	15.690	15.644	15.656	15.604	16.204	16.038	15.505	16.045	15.013	15.599	15.666	15.581	15.621	15.605
mg:	66.310	66.680	66.050	66.010	65.510	65.140	68.140	74.110	61.190	71.030	71.060	55.630	56.100	56.810	55.990	55.450
Al4	2.232	2.268	2.181	2.205	2.213	2.193	2.273	2.256	2.613	2.344	2.537	2.269	2.320	2.259	2.216	2.241
Al6	0.253	0.249	0.241	0.333	0.172	0.281	0.192	0.479	0.094	0.285	0.095	0.218	0.191	0.243	0.249	0.211
Fe3T	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Z site:	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
Y site:	5.780	5.868	5.811	5.847	5.775	5.916	6.312	6.245	5.917	6.280	5.404	5.693	5.721	5.688	5.696	5.678
X site:	1.941	1.892	1.879	1.797	1.880	1.688	1.892	1.793	1.588	1.765	1.608	1.906	1.946	1.893	1.925	1.927
Anions:	0.000	0.000	0.000	0.000	0.000	0.000	2.589	2.698	4.234	2.690	4.680	0.000	0.000	0.000	0.000	0.000

	Enclaves II.															
	17	18	19	20	21	22*	23*	24*	25	26	27	28	29	30	31*	32*
SiO_2	38.34	37.84	38.52	38.27	36.27	36.56	36.25	36.69	37.28	37.14	37.32	37.60	37.38	37.02	36.63	37.28
TiO_2	2.82	3.06	3.13	3.25	2.96	2.48	2.19	2.86	1.75	1.67	1.57	3.33	3.26	2.57	2.52	3.60
Al_2O_3	14.15	14.14	15.00	15.28	15.26	15.44	14.53	14.54	15.41	15.46	15.57	15.03	15.15	14.90	15.64	15.21
Fe_2O_3	-	-	-	-	-	2.90	8.23	3.26	-	-	-	-	-	-	7.26	1.90
FeO	17.25	17.44	18.21	18.40	18.65	16.59	11.51	16.68	18.37	18.06	18.01	19.03	18.89	19.47	12.00	16.86
MnO	0.22	0.23	0.29	0.25	0.28	0.36	0.35	0.29	0.22	0.23	0.19	0.24	0.21	0.20	0.29	0.30
MgO	12.95	12.85	11.59	11.97	11.43	11.74	12.51	12.12	12.14	12.25	12.50	11.07	11.49	11.26	11.72	11.23
CaO	0.05	0.08	0.00	0.00	0.00	0.73	0.61	1.01	0.10	0.02	0.00	0.02	0.00	0.00	0.36	1.09
Na_2O	0.10	0.08	0.06	0.08	0.07	0.14	0.14	0.12	0.06	0.09	0.10	0.09	0.09	0.07	0.15	0.10
K_2O	9.85	9.74	10.24	9.83	8.62	9.00	8.07	9.18	9.63	9.47	9.39	9.61	9.49	9.61	7.87	8.82
H_2O^+	-	-	-	-	-	3.43	4.60	2.16	-	-	-	-	-	-	4.35	2.93
Cl	-	-	-	-	-	0.11	0.00	0.16	-	-	-	-	-	-	0.00	0.11
Total	95.73	95.46	97.04	97.33	93.54	99.48	98.99	99.07	94.96	94.39	94.65	96.02	95.96	95.10	98.79	99.43
Numbers of ions on the basis of 22(O) or 24 (O.OH)																
	22(O)					**24(O.OH)**			**22 (O)**						**24(O,OH)**	
Si	5.766	5.718	5.741	5.680	5.603	5.578	5.417	5.728	5.680	5.681	5.683	5.680	5.645	5.668	5.470	5.704
Ti	0.319	0.348	0.351	0.363	0.344	0.285	0.246	0.336	0.200	0.192	0.180	0.378	0.370	0.296	0.283	0.414
Al	2.508	2.518	2.635	2.673	2.778	2.777	2.559	2.675	2.767	2.787	2.794	2.676	2.696	2.689	2.753	2.743
Fe^{3+}	-	-	-	-	-	0.333	0.925	0.383	-	-	-	-	-	-	0.816	0.219
Fe^{2+}	2.170	2.204	2.270	2.284	2.409	2.117	1.438	2.178	2.341	2.310	2.294	2.404	2.385	2.493	1.499	2.157
Mn	0.028	0.029	0.037	0.031	0.037	0.047	0.044	0.038	0.028	0.030	0.024	0.031	0.027	0.026	0.037	0.039
Mg	2.903	2.894	2.575	2.648	2.632	2.670	2.786	2.820	2.757	2.793	2.837	2.493	2.586	2.570	2.609	2.561
Ca	0.008	0.013	-	-	-	0.119	0.098	0.169	0.016	0.003	-	0.003	-	-	0.058	0.179
Na	0.029	0.023	0.017	0.023	0.021	0.041	0.041	0.036	0.018	0.027	0.030	0.026	0.026	0.021	0.043	0.030
K	1.890	1.878	1.947	1.861	1.699	1.752	1.538	1.828	1.872	1.848	1.824	1.852	1.828	1.877	1.499	1.721
OH	-	-	-	-	-	3.491	4.585	2.250	-	-	-	-	-	-	4.333	2.990
Cl	-	-	-	-	-	0.028	-	0.042	-	-	-	-	-	-	-	0.029
ΣCAT	15.620	15.625	15.572	15.563	15.523	15.747	15.092	16.235	15.680	15.670	15.666	15.543	15.564	15.640	15.066	15.795
mg:	57.230	56.770	53.150	53.690	52.210	55.770	65.950	56.430	54.090	54.730	55.300	50.910	52.020	50.760	63.510	54.280
Al4	2.234	2.282	2.259	2.320	2.397	2.422	2.559	2.272	2.320	2.319	2.317	2.320	2.355	2.332	2.530	2.296
Al6	0.274	0.236	0.376	0.353	0.382	0.355	-	0.404	0.448	0.468	0.478	0.356	0.341	0.357	0.223	0.447
Fe3T	-	-	-	-	-	-	0.025	-	-	-	-	-	-	-	-	-
Z site:	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
Y site:	5.693	5.711	5.608	5.679	5.803	5.806	5.415	6.159	5.774	5.793	5.813	5.661	5.709	5.742	5.466	5.837
X site:	1.927	1.914	1.964	1.884	1.720	1.912	1.676	2.033	1.906	1.878	1.854	1.881	1.854	1.898	1.600	1.930
Anions:	0.000	0.000	0.000	0.000	0.000	3.491	4.585	2.250	0.000	0.000	0.000	0.000	0.000	0.000	4.333	2.990

1-6. Mórágy outcrop (enclave I: amphibole monzonite); **7-8.** Mórágy quarry (enclave I: biotite amphibole quartz monzonite); **9.** Mórágy quarry (enclave I: amphibole biotite monzogranite); **10.** Feked quarry (enclave I: biotite amphibole quartz monzonite); **11.** Véménd quarry (enclave I: amphibole biotite quartz monzonite); **12-18.** Mórágy outcrop (enclave II: pyroxene amphibole monzonite); **19-21.** Mórágy outcrop (enclave II: amphibole monzonite); **22.** Mórágy quarry (enclave II: amphibole biotite monzogranite); **23-24.** Erdősmecske quarry (enclave II: amphibole biotite quartz monzonite); **25-30.** Erdősmecske quarry (enclave II: amphibole monzonite); **31.** Kismórágy quarry (enclave II: amphibole biotite quartz monzonite); **32.** Kismórágy quarry (enclave II: amphibole biotite monzogranite);
* wet chemical analyses, not marked: electron microprobe analyses.

Table 3: Tisia Terrane II.: biotite compositions of mafic enclaves and granitoids from Mecsek Mts.

	East Mecsek Mts.															
	Enclaves II.						Granitoids									
	33	34	35	36	37	38	39	40	41	42	43	44*	45*	46*	47*	48*
SiO_2	37,68	38,09	38,13	37.24	38.40	38.03	37.45	37.39	37.61	37.50	38,28	37.08	37.13	36.21	37.08	37.28
TiO_2	2.14	1.22	3.08	3.25	1.89	1.32	1.91	1.94	2.43	1.99	1.25	2,61	2.75	3.30	3,67	3,25
Al_2O_3	14,61	15,44	14,62	14.93	15.36	14.68	15.56	15.51	15,36	16,00	15.45	14,69	15.35	15.43	14.23	15.08
Fe_2O_3	-	-	-	-	-	-	-	-	-	-	-	3,11	2.34	3.75	3.04	1.92
FeO	16,44	15,98	17.41	17,43	16,79	16,35	18,80	18.79	19.27	19.34	18,57	16.69	16.59	15.34	17.23	15.91
MnO	0,17	0,17	0,21	0.19	0.14	0.17	0.24	0.27	0,25	0,29	0,20	0,30	0.31	0,32	0,29	0.20
MgO	13.34	13.37	12.27	12,33	12.81	12.90	11.27	11.27	11.26	11.64	13.02	12.60	12,47	11,81	11,67	12,19
CaO	0.01	0,02	0,04	0,63	0,03	0.02	0,00	0,00	0.04	0.05	0.17	0.00	0.00	0.29	0.00	1.03
Na_2O	0.03	0.03	0.05	0,04	0,05	0,03	0.10	0.07	0,09	0.10	0.11	0,16	0,20	0,10	0,15	0,14
K_2O	9,91	10,03	9,66	9,63	9,91	9.93	9,69	9,54	9,80	9,70	8,30	8,92	9.22	8.45	9.12	8.88
H_2O^+	-	-	-	-	-	-	-	-	-	-	-	3.12	3.25	4.68	3,09	3.48
Cl	-	-	-	-	-	-	-	-	-	-	-	0.00	0.00	0.12	0.00	0,15
Total	94,33	94,35	95,47	95,67	95,38	93.43	95,02	94.78	96,11	96,61	95,35	99,28	99.61	99.80	99.57	99.51

	East Mecsek Mts. (Granitoids)							West Mecsek Mts.					North Mecsek Mts.				
	49	50	51	52	53	54*	55*	56	57	58	59	60	61	62	63	64	65
SiO_2	38.07	37.40	38.15	38.03	37.98	38.40	37.90	38.95	38.43	38,67	37.84	37.77	36,68	35,77	35.98	36,61	36.44
TiO_2	2,81	3,16	2,22	3,07	2,07	2.49	2.66	1.28	1.40	1.38	1.53	1,29	4.84	5.17	4.75	4.71	4.71
Al_2O_3	14.57	14.68	15.18	14.99	15.80	17.80	14.10	14.10	14.10	14.49	14,19	13.88	13.85	13.23	13.63	13.19	13.62
Fe_2O_3	-	-	-	-	-	6.32	3.31	-	-	-	-	-	-	-	-	-	-
FeO	19.10	18.98	18.81	18.85	19.04	16.30	14.50	17.11	16,16	17.03	17.67	17.69	24.35	24.61	24.21	25.20	25.07
MnO	0,29	0,31	0,28	0.24	0.23	0.33	0.25	0.34	0.33	0.30	0,43	0.45	0.33	0.28	0,29	0,29	0,37
MgO	10,50	10,46	10,86	10,48	11.03	4,95	13,20	14.45	14.31	14.11	13.79	13.81	7.50	7.79	7.74	7.50	7.50
CaO	0.00	0.00	0.04	0.00	0.00	0.33	0.87	0.05	0.00	0,00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na_2O	0.07	0.10	0.07	0.10	0.08	0.36	0.17	0.00	0.00	0.00	0.00	0.00	0.06	0.08	0.09	0.06	0.08
K_2O	9.29	9.21	9.31	9.28	9.34	6.96	9.30	9,73	9,76	9.58	9.71	9.76	9.61	9.30	9.55	9.46	9.48
H_2O^+	-	-	-	-	-	4.56	3.04	-	-	-	-	-	-	-	-	-	-
Cl	-	-	-	-	-	0,00	0,00	-	-	-	-	-	-	-	-	-	-
Total	94.70	94.30	94.92	95.04	95.57	98.80	99.30	96.01	94.49	95.56	95.16	94.65	97.22	96.23	96.24	97.02	97.27

Numbers of ions on the basis of 22(O) or 24(O,OH)

	33	34	35	36	37	38	39	40	41	42	43	44*	45*	46*	47*	48*
									22(O)			24(O,OH)		24(O,OH)		
Si	5.735	5.771	5.745	5.622	5.768	5.833	5.710	5.712	5.686	5.636	5.751	5.675	5.647	5.394	5.683	5.643
Ti	0,245	0.139	0,349	0,369	0,213	0,152	0.219	0.223	0,276	0,225	0.141	0.300	0.315	0.370	0.423	0.370
Al	2,621	2,757	2,596	2,656	2,719	2,654	2.796	2.793	2,737	2,834	2,736	2,650	2.751	2,709	2,570	2,690
Fe3+	-	-	-	-	-	-	-	-	-	-	-	0,358	0,268	0,420	0,351	0,219
Fe2+	2,092	2,025	2,194	2,200	2,109	2,097	2,397	2,401	2,436	2,431	2,333	2.136	2.110	1,911	2.208	2,014
Mn	0,022	0.022	0.027	0,024	0,018	0,022	0.031	0,035	0,032	0,037	0,025	0,039	0,040	0,040	0,038	0,026
Mg	3,026	3,020	2,755	2,774	2,868	2.949	2,561	2,566	2.537	2.607	2.915	2.874	2.827	2.622	2.666	2.750
Ca	0,002	0.003	0.006	0,102	0.005	0.003	-	-	0,006	0,080	0,027	-	-	0,046	-	0,167
Na	0.009	0,009	0,015	0.012	0.014	0,009	0.030	0,021	0.026	0.029	0.032	0.047	0,059	0,029	0,045	0,041
K	1.924	1,939	1,857	1,854	1,899	1.943	1,885	1,859	1,890	1,860	1.591	1.742	1.789	1.606	1.783	1.715
OH	-	-	-	-	-	-	-	-	-	-	-	3.185	3,297	4,650	3,159	3.514
Cl	-	-	-	-	-	-	-	-	-	-	-	-	-	0.030	-	0.038
ΣCAT	15.676	15.684	15,543	15,614	15,615	15,663	15,629	15,609	15.627	15.666	15.551	15.822	15.804	15.178	15,767	15,672
mg:	59,120	59,860	55,670	55,760	57,630	58,450	51,650	51,660	51,010	51,760	55,550	57,360	57.260	57.840	54.690	57.720
Al4	2.265	2.229	2.255	2.378	2.232	2.167	2.290	2.288	2.314	2.364	2.249	2.325	2.353	2.606	2.317	2.357
Al6	0.356	0.529	0.341	0.278	0.488	0.487	0.507	0.504	0.423	0.470	0.486	0.325	0.398	0.103	0.254	0.333
Z site:	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
Y site:	5.741	5.734	5.666	5.646	5.697	5.708	5.715	5.729	5.705	5.770	5.901	6.033	5.957	5.467	5.939	5.711
X site:	1.934	1.951	1.878	1.968	1.918	1.955	1.914	1.880	1.923	1.897	1.650	1.789	1.847	1.681	1.828	1.923
Anions:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	3.185	3.297	4.650	3.159	3.514

	49	50	51	52	53	54*	55*	56	57	58	59	60	61	62	63	64	65
						24(O,OH)							22 (O)				
Si	5.817	5.746	5.801	5.779	5.739	5.732	5.770	5.823	5.821	5.800	5,743	5.770	5,638	5.575	5,598	5,663	5,621
Ti	0,323	0,365	0.254	0,351	0,235	0,280	0,305	0,144	0,159	0,156	0.175	0.148	0.559	0,606	0.556	0,548	0,546
Al	2,624	2,658	2,720	2,684	2,814	3,131	2,530	2,484	2,517	2,562	2,538	2,499	2,509	2,430	2,499	2,405	2,476
Fe3+	-	-	-	-	-	0,710	0,379	-	-	-	-	-	-	-	-	-	-
Fe2+	2,441	2,438	2,392	2,395	2,406	2,035	1,846	2,139	2,047	2,136	2,243	2,260	3,130	3,208	3,150	3,260	3,234
Mn	0,038	0,040	0,036	0,031	0,029	0,042	0,032	0,043	0,042	0,038	0,055	0,058	0,043	0,037	0,038	0,038	0,048
Mg	2,391	2,395	2,461	2,374	2,484	1,101	2,995	3,220	3,231	3,155	3,119	3,145	1,718	1,810	1,795	1,729	1,724
Ca	-	-	0,007	-	-	0,053	0,142	0,008	-	-	-	-	-	-	-	-	-
Na	0,021	0,030	0,021	0,029	0,023	0,104	0,050	-	-	-	-	-	0,018	0,024	0,027	0,018	0,024
K	1,811	1,805	1,006	1,799	1,800	1,325	1,806	1,856	1,886	1,833	1,880	1,902	1,884	1,849	1,895	1,867	1,865
OH	-	-	-	-	-	4,540	3,087	-	-	-	-	-	-	-	-	-	-
Cl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ΣCAT	15,464	15,477	15,498	15,442	15,531	14,512	15,855	15,718	15,703	15,679	15,753	15,783	15,499	15,540	15,558	15,528	15,539
mg:	49,490	49,550	50,720	49,770	50,800	35,110	61,870	60,080	61,210	59,630	58,170	58,180	35,440	36,060	36,300	34,660	34,770
Al4	2.183	2.254	2.199	2.221	2.261	2.268	2.230	2.177	2.179	2.200	2.257	2.230	2.362	2.425	2.402	2.337	2.379
Al6	0.440	0.404	0.522	0.463	0.552	0.863	0.300	0.308	0.338	0.362	0.281	0.270	0.147	0.006	0.097	0.068	0.097
Z site:	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
Y site:	5.632	5.643	5.665	5.614	5.707	5.030	5.857	5.854	5.818	5.846	5.873	5.881	5.597	5.666	5.636	5.643	5.650
X site:	1.831	1.835	1.833	1.828	1.824	1.482	1.998	1.864	1.886	1.833	1.880	1.902	1.902	1.873	1.922	1.885	1.889
Anions:	0.000	0.000	0.000	0.000	0.000	4.540	3.087	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

33-38. Fazekasboda-1. core sample, 113.6 m, (enclave II: amphibole monzonite); **39-43.** Mórágy quarry (microcline megacryst-bearing amfibole biotite monzogranite); **44-46.** Erdősmecske quarry (microline megacryst-bearing biotite granitoid); **47-48.** Kismórágy quarry (microcline megacryst-bearing biotite granitoid); **49-53.** Kismórágy (microcline megacryst-bearing biotite granitoid); **54.** Kismórágy quarry (micrograniite); **55.** Mórágy outcrop (amphibole-bearing pegmatoid); **56-60.** Almáskeresztúr core sample, 282.9 m (amphibole biotite quartz monzodiorite); **61-65.** Szalatnak-3. core sample - 564 m (granitoid).

*wet chemical analyses, not marked: electron microprobe analyses

Table 4. Tisia Terrane III.: biotite compositions of granitoids from the Danube-Tisza Interfluve and East of river Tisza (Hungary)

	Danube-Tisza Interfluve								East of river Tisza								
	1*	**2**	**3**	**4**	**5**	**6**	**7***	**8***	**9***	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
SiO_2	36,37	37.27	36,82	36.81	36,72	36,58	35.50	36,44	34.50	37,76	38,99	38.66	38,91	39.17	35.73	36,58	36.23
TiO_2	4.12	3,46	3.46	3.45	3,42	3.39	3,31	3,43	3,54	2,19	1.45	2,13	2.18	1,89	3,07	2,92	3,08
Al_2O_3	15,89	15.72	15.42	15.54	15,28	15,28	19,76	16,41	17.40	16,20	16,16	15.99	16,25	16,34	16.86	16,52	16.48
Fe_2O_3	3,45	-	-	-	-	-	1,61	3.63	4,75	-	-	-	-	-	-	-	-
FeO	15.09	18,97	18.90	19.07	18,49	18.97	17,48	14.72	17,70	11,67	13.44	12.48	12,77	12.15	20.38	20,75	20.54
MnO	0,30	0.29	0,29	0,32	0.31	0,31	0.23	0.35	0.28	0,16	0,21	0.17	0.15	0,19	0.54	0.47	0.50
MgO	11.27	10.72	10.89	10,47	11,03	10.85	7,93	11.97	8.52	15.73	14.68	14,77	14.98	14,93	8.63	8.53	8,39
CaO	0,33	0.07	0,06	0.06	0,05	0,03	0.16	0,17	0.13	0,06	0,00	0.03	0,00	0,04	0,03	0,04	0.04
Na_2O	0,09	0,00	0.00	0,00	0,00	0.00	0,10	0.16	0,25	0,15	0.11	0,09	0.08	0,13	0,03	0,17	0,10
K_2O	8.80	9.24	9,34	9.58	9,29	9.25	9,29	9,30	8.40	9,76	9.90	9.95	10,01	9.94	9.45	9,63	9.36
H_2O^+	3.82	-	-	-	-	-	3,99	2.86	3,48	-	-	-	-	-	-	-	-
Cl	0,10	-	-	-	-	-	0,08	0.11	0,00	-	-	-	-	-	-	-	-
Total	99.63	95.74	95,18	95,30	94.59	94,66	99.44	99.55	98,95	93.68	94,94	94,27	95.33	94,78	94,72	95.61	94,72
Numbers of ions on the basis of 22(O) or 24(O.OH)																	
	24(O.OH)			**22(O)**			**24 (O,OH)**						**22(O)**				
Si	5.473	5,632	5,603	5.613	5.620	5,608	5,361	5,553	5,324	5.642	5,778	5,752	5.729	5,778	5.523	5,605	5,596
Ti	0,466	0.393	0,396	0,396	0.394	0,391	0.376	0,393	0.411	0,246	0,162	0,238	0.241	0,210	0.357	0,336	0.358
Al	2,818	2,800	2.769	2,793	2.756	2,761	3,517	2.947	3.164	2.853	2,822	2,804	2.820	2,841	3,071	2,983	3,000
Fe^{3+}	0.391	-	-	-	-	-	0,183	0,416	0.552	-	-	-	-	-	-	-	-
Fe^{2+}	1,899	2,397	2,408	2,432	2.367	2,432	2,207	1,876	2,284	1,458	1,666	1,553	1.572	1,499	2.634	2,659	2,653
Mn	0.038	0.037	0,037	0.041	0,040	0,040	0,029	0,045	0.036	0,020	0.026	0.021	0,019	0,024	0,071	0,061	0.065
Mg	2,528	2.414	2,473	2,379	2.516	2,479	1.785	2,719	1,960	3,503	3,243	3,276	3,287	3,282	1,988	1,948	1,931
Ca	0.053	0,011	0,010	0.010	0.008	0.005	0,026	0,028	0,021	0,010	-	0,005	-	0,006	0,005	0,007	0,007
Na	0,026	-	-	-	-	-	0,029	0,047	0.075	0,043	0,032	0,026	0,023	0,037	0,009	0,051	0,030
K	1,689	1,781	1.815	1,863	1,814	1,809	1,789	1,808	1,653	1,860	1,872	1,889	1.880	1,870	1,863	1,882	1,844
OH	3,835	-	-	-	-	-	4,019	2,907	3.582	-	-	-	-	-	-	-	-
Cl	0,025	-	-	-	-	-	0,020	0,028	-	-	-	-	-	-	-	-	-
ΣCAT	15,409	15,465	15.517	15,527	15.514	15,525	15.323	15,860	15.480	15,637	15,600	15,564	15,571	15,546	15,521	15,533	15,484
mg:	57.100	50,180	50,670	49.460	51,540	50.480	44,710	59,180	46,180	70,610	66.070	67,830	67,650	68,650	43,010	42,290	49,130
Al4	2,527	2.368	2.391	2.387	2.380	2,392	2.639	2,447	2.676	2,358	2,222	2.248	2,271	2,222	2.477	2.395	2.404
Al6	0,292	0.431	0,378	0,405	0.376	0,369	0,878	0.500	0.488	0.495	0,601	0,556	0.548	0,618	0,594	0,589	0,595
Z site:	8,000	8.000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000	8,000
Y site:	5.614	5,673	5,692	5,653	5,693	5,711	5.458	5,949	5,730	5,723	5,697	5,645	5,668	5.632	5,644	5,593	5,603
X site:	1,769	1,792	1,825	1,873	1,822	1,814	1,844	1,883	1,749	1,913	1,903	1,919	1,903	1,914	1,877	1,939	1,881

1. Kecskemét No 2.core sample,1085 m (biotite granite); **2-6.** Kecskemét No.2. core sample, 1152.5-1154.5 m (biotite monzogranite); **7.** Cegléd No.1. 1508 m (biotite granitegneiss); **8.** Mezőhegyes No. 13. 1185.66 m (biotite monzogranite); **9.** Pitvaros South-1. core sample 2606-2608 m (muscovite biotite monzogranite); **10-14.** Battonya North-2. (amphibole granodiorite); **15-17.** Battonya-64, 1024.5-1025.5 m (muscovite biotite monzogranite).
*wet chemical analyses; not marked= electron microprobe analyses

Table 5. Biotite compositions of granitoids South Bohemian Plutonic Complex (Austria)

	1	2	3	4	5	6	7	8	9	10	11	12
SiO_2	37,20	37.50	36,90	35.90	33.90	34,80	34.90	35.90	32,30	35.80	36,00	33,40
TiO_2	4.32	3.74	4.47	6.74	5,15	4.82	4,97	3.00	2.60	3,21	2.97	2.93
Al_2O_3	14.70	13.70	14,10	13.70	14.50	14,30	14.30	17.20	19.70	17.30	16,70	17,90
Fe_2O_3	0.78	2.51	2.51	1,73	3,85	3.31	2,38	1.29	4.66	2,00	2.58	4.54
FeO	18.20	16.70	17,60	20.10	21.60	21,60	22.90	22.00	20.30	22.00	17.80	19.30
MnO	0,23	0.23	0.27	0,09	0.24	0.21	0,27	0.17	0.29	0.18	0.30	0.31
MgO	11.90	11,70	11.70	9.48	7.53	7.18	6.74	6.80	8.02	6.35	9.40	8.00
CaO	1,02	1.00	0,38	0.18	0.23	0.14	0.45	0.22	0,06	0.17	1,00	0,42
Na_2O	0,08	0.14	0.10	0.15	0.15	0.09	0.10	0,04	0.03	0.09	0.01	0.05
K_2O	8.12	8,84	8,34	8.71	8.46	8.32	8.70	8.78	8,96	8.88	8,35	8,68
H_2O^+	3,76	3,25	2.60	2,71	2,83	3.93	3,07	4.27	2.33	3,32	4.22	3.46
Total	100.31	99.31	98,97	99.49	98.44	98.70	98.78	99,67	99,25	99.30	99.33	98,99
Numbers of ions on the basis of 22(O) or 24(O.OH)												
Si	5.587	5.734	5.707	5,593	5.415	5.442	5,546	5,489	5.122	5.569	5.450	5,209
Ti	0.488	0,430	0.520	0,790	0,619	0.567	0.594	0,345	0.310	0.375	0.338	0.344
Al	2.602	2.469	2.570	2,515	2.730	2.636	2,678	3.099	3.682	3.171	2.980	3.290
Fe^{3+}	0.088	0,289	0.292	0,203	0,463	0.389	0.285	0,148	0.556	0.234	0.294	0.533
Fe^{2+}	2,286	2.135	2.277	2,619	2.885	2,825	3.043	2.813	2,692	2.862	2,253	2.517
Mn	0.029	0,030	0.035	0,012	0,032	0.028	0,036	0,022	0.039	0.024	0.038	0.041
Mg	2.664	2,666	2,697	2.201	1.793	1.674	1.596	1,550	1.895	1.472	2,121	1.860
Ca	0,164	0.164	0,063	0,030	0,039	0.023	0,077	0.036	0,010	0.028	0,162	0,070
Na	0.023	0,041	0,030	0.045	0.046	0.027	0.031	0,012	0,009	0.027	0,003	0.015
K	1,556	1.724	1.645	1,731	1.724	1,660	1,763	1.712	1,812	1.762	1,612	1,727
OH	3.767	3,315	2.682	2,816	3,015	4.100	3.254	4,355	2.464	3.445	4,261	3,600
ΣCAT	15.486	15.682	15.837	15,738	15,747	15.271	15,649	15.226	16.127	15.525	15.252	15,606
mg:	53.820	55.530	54,230	45.670	38,310	37.200	34.400	35.510	41.320	33.970	48.480	42.480
Al4	2.413	2.266	2.293	2,407	2.585	2.558	2,454	2,511	2.878	2.431	2.550	2,791
Al6	0.188	0,203	0,278	0.108	0,145	0.078	0.224	0,588	0.803	0.740	0,429	0.500
Z site:	8.000	8,000	8.000	8,000	8,000	8.000	8.000	8,000	8.000	8,000	8,000	8.000
Y site:	5,743	5.753	6,099	5.932	5.937	5.561	5,778	5.466	6,296	5.707	5,474	5,794
X site:	1.743	1,929	1,738	1,806	1,810	1.710	1.871	1,760	1.832	1,817	1,777	1.812

	13	14	15	16	17	18	19	20	21	22	23	24
SiO_2	32.20	33.50	34.10	37,30	34,60	37.10	33.60	34.20	35.20	33,70	34.50	32,00
TiO_2	2,57	2.88	2.74	2,60	2.80	3,00	3.24	3.34	3,18	2.70	2,82	2.06
Al_2O_3	19.70	19,40	18.80	18,50	19.00	17.30	17,20	16.90	17.80	18.80	17.50	20,00
Fe_2O_3	4,58	2.30	3.50	3,48	3.54	1,46	4.74	6.37	4,47	2.87	2,44	1.62
FeO	19.90	17.80	19.80	17,90	18,90	18.40	19.50	16.20	19,30	23.20	18.50	22.10
MnO	0,23	0.33	0,26	0.23	0.25	0,28	0.34	0,33	0.26	0,30	0,27	0.01
MgO	8.18	9.30	8.40	6,96	7.14	8.82	7.52	8.86	7.42	4.75	10.60	8.26
CaO	0.22	0,30	0,08	0,11	0.14	0.94	0,03	0.13	0.09	0,06	0.26	0,02
Na_2O	0,05	0,04	0,04	0,10	0.08	0.01	0,10	0.15	0.09	0.08	0.07	0.17
K_2O	8.20	9,66	8.24	9,23	8.87	8.48	8,62	8.90	8.94	9,08	9.35	9,95
H_2O^+	3,51	3.73	3.80	3,24	3.62	3,56	3.64	3.82	1,54	4.00	3,38	3.57
Total	99.34	99.24	99.76	99,65	98.94	99.35	98,53	99.20	98.29	99,54	99.69	99,76
Numbers of ions on the basis of 22(O) or 24(O.OH)												
Si	5.002	5.147	5.217	5.681	5,336	5.635	5.257	5.254	5,627	5,254	5.307	5.002
Ti	0,300	0,333	0,315	0,298	0,325	0,343	0.381	0.386	0.382	0.317	0.326	0,242
Al	3.606	3.513	3.390	3.320	3.454	3,097	3.171	3.060	3.353	3.454	3.173	3.685
Fe^{3+}	0.535	0,266	0,403	0.390	0.411	0,167	0.558	0,736	0.538	0.337	0,282	0.191
Fe^{2+}	2,585	2,287	2.533	2,280	2,438	2.337	2,551	2.081	2.580	3,025	2.380	2,889
Mn	0,030	0,043	0.034	0.030	0.033	0,036	0.045	0.043	0,035	0.040	0.035	0,001
Mg	1,894	2,130	1.916	1,580	1.641	1,997	1.754	2.029	1,768	1.104	2,430	1,925
Ca	0,037	0,049	0,013	0,018	0,023	0.153	0,005	0.021	0,015	0,010	0.043	0.003
Na	0,015	0.012	0.012	0,030	0,024	0.003	0,030	0.045	0,028	0,024	0,021	0,052
K	1,625	1,893	1.608	1,793	1,745	1.643	1.720	1.744	1,823	1,806	1.835	1.984
OH	3,637	3.822	3,878	3,291	3.724	3,607	3.799	3,914	1.642	4.160	3.468	3.723
ΣCAT	15.628	15.672	15.441	15.427	15,429	15.410	15.473	15.399	16.149	15.369	15.832	15,974
mg:	42,290	48.220	43.050	40,930	40.240	46,060	40,730	49.360	40,650	26,730	50.530	39,980
Al4	2.998	2.853	2,783	2.319	2,664	2,365	2.743	2,746	2.373	2.746	2,693	2.998
Al6	0,608	0,659	0.607	1,001	0.790	0.732	0.428	0.314	0,980	0.708	0.480	0,687
Z site:	8,000	8,000	8,000	8,000	8,000	8,000	8.000	8,000	8.000	8,000	8,000	8,000
Y site:	5,952	5,718	5.808	5,587	5,637	5.611	5,717	5,589	6,283	5,529	5,934	5,935
X site:	1,676	1,954	1,633	1,840	1.792	1,799	1.756	1,810	1.866	1,840	1,898	2,039

1. Gebharts (quartz monzodiorite); **2.** Rastenberg Ottenstein (granodiorite); **3.** Rastenberg Ottenstein (granodiorite); **4.** E of Sarleinsbach, 1.5 km (pyroxene-bearing granitoid, basic part); **5.** W. of Sarleinsbach 1 km (pyroxene-bearing granodiorite); **6.** same as No.5.; **7.** Arnreit (Weinsberg-type granitoid); **8.** Waldhausen (Weinsberg-type granitoid); **9.** Langschlag (Weinsberg type granitoid); **10.** Bärnkopf (Weinsberg-type granitoid); **11.** Perg (Mauthausen-type granitoid); **12.** Schrems, Hartberg quarry: lower part, (Eisgarn-type granitoid); **13.** Schrems, Hartberg quarry: upper part (Eisgarn-Weinsberg mixed-type granitoid); **14.** Schrems, Hartberg quarry (Eisgarn-type granitoid); **15.** Hartberg quarry (Enclaves of Eisgarn-Weinsberg mixed-type granitoid); **16.** Aalfang (Eisgarn-type granitoid); **17.** Aalfang (Eisgarn-type granitoid); **18.** Aalfang (Eisgarn-type granitoid); **19.** S.Martin (Eisgarn-type granitoid); **20.** Weitra quarry (the border of Weinsberg and Eisgarn-type granitoid); **21.** W. of Liebenau (Karlstift-type granitoid); **22.** Windhagen quarry (Plochwald-type granitoid); **23.** Spörbichl quarry (granodiorite in Weinsberg-type granitoid); **24.** Windhagen quarry (kingizite in Plochwald-type granitoid).
All wet chemical analyses.

Table 6. Biotite compositions of granitoids from Western Carpathian Plutonic Complex (Inner -zone)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SiO_2	34.25	36.60	36.62	36.72	36.21	35.29	33.86	34.76	34.94	35.03	35.04	35.55	35.75	36.03	36.72
TiO_2	3.80	2.05	2.45	2.47	2.80	3.41	2.65	3.33	3.25	3.14	2.60	2.88	3.27	3.35	2.75
Al_2O_3	13.25	15.80	12.37	15.77	16.68	15.01	14.93	14.13	14.99	14.69	14.41	14.51	14.73	16.02	18.08
Fe_2O_3	7.18	5.68	9.65	5.25	4.26	4.60	4.73	2.36	5.19	3.87	5.95	5.66	1.30	4.46	5.40
FeO	15.09	11.80	11.79	14.74	16.92	15.48	20.41	15.26	15.38	18.30	17.40	17.08	18.78	14.31	16.92
MnO	0.20	0.22	0.28	0.32	0.38	0.32	0.40	0.46	0.35	0.29	0.38	0.51	0.35	0.10	0.35
MgO	12.07	14.19	13.01	11.02	8.58	10.74	8.87	12.92	11.60	9.90	10.13	9.08	10.15	12.90	7.88
CaO	0.93	1.65	1.11	1.81	0.88	0.77	0.65	4.90	2.65	2.60	0.50	2.15	3.40	1.12	0.70
Na_2O	0.16	0.16	0.16	0.12	0.14	0.12	0.12	0.24	0.17	0.22	0.12	0.24	0.25	0.20	0.17
K_2O	9.30	9.20	8.60	10.07	8.20	9.66	9.40	6.25	7.50	7.90	9.60	8.48	7.92	8.70	9.10
H_2O^+	3.03	1.86	2.66	1.26	3.37	1.96	4.10	4.67	3.18	3.31	3.40	3.12	3.18	2.65	2.01
Total	99.26	99.21	98.70	99.55	98.42	97.36	100.12	99.28	99.20	99.25	99.53	99.26	99.08	99.84	100.08
Numbers of ions on the basis of 22(O) or 24(O.OH)															
Si	5.348	5.637	5.675	5.773	5.580	5.635	5.258	5.226	5.376	5.441	5.451	5.538	5.550	5.490	5.676
Ti	0.446	0.237	0.285	0.292	0.324	0.409	0.309	0.377	0.376	0.367	0.304	0.337	0.382	0.384	0.320
Al	2.438	2.868	2.259	2.922	3.030	2.825	2.733	2.504	2.718	2.689	2.642	2.664	2.695	2.877	3.294
Fe3+	0.844	0.658	1.125	0.621	0.494	0.553	0.553	0.267	0.601	0.452	0.697	0.663	0.152	0.511	0.628
Fe2+	1.970	1.520	1.528	1.938	2.181	2.067	2.651	1.919	1.979	2.377	2.264	2.225	2.438	1.823	2.187
Mn	0.026	0.029	0.037	0.043	0.050	0.043	0.053	0.058	0.046	0.038	0.050	0.067	0.046	0.013	0.046
Mg	2.809	3.257	3.005	2.582	1.971	2.556	2.053	2.895	2.661	2.292	2.349	2.108	2.349	2.930	1.816
Ca	0.155	0.272	0.184	0.305	0.145	0.132	0.108	0.789	0.437	0.433	0.083	0.359	0.566	0.183	0.116
Na	0.048	0.048	0.048	0.036	0.042	0.037	0.036	0.070	0.051	0.066	0.036	0.072	0.075	0.059	0.051
K	1.852	1.808	1.700	2.019	1.612	1.968	1.862	1.199	1.472	1.565	1.905	1.685	1.568	1.691	1.794
OH	3.156	1.911	2.750	1.321	3.464	2.088	4.247	4.683	3.264	3.430	3.528	3.242	3.293	2.693	2.073
ΣCAT	15.937	16.334	15.846	16.531	15.428	16.225	15.615	15.304	15.717	15.721	15.781	15.719	15.820	15.960	15.929
mg:	58.780	68.190	66.290	57.130	47.470	55.290	43.650	60.150	57.350	49.080	50.920	48.650	42.060	61.650	45.350
Al4	2.438	2.363	2.259	2.227	2.420	2.365	2.733	2.504	2.624	2.559	2.549	2.462	2.450	2.510	2.324
Al6	-	0.505	-	0.694	0.610	0.460	-	-	0.095	0.131	0.093	0.201	0.245	0.367	0.971
Fe3T	0.214	-	0.066	-	-	-	0.009	0.267	-	-	-	-	-	-	-
Z site:	8.000	8.000	8.000	8.000	8.000	8.000	8.000	7.997	8.000	8.000	8.000	8.000	8.000	8.000	8.000
Y site:	5.881	6.207	5.914	6.170	5.629	6.088	5.609	5.249	5.757	5.657	5.757	5.602	5.611	6.028	5.967
X site:	2.056	2.127	1.932	2.361	1.799	2.136	2.006	2.058	1.960	2.064	2.024	2.116	2.209	1.933	1.961

	16	17	18	19	20	21	22	23	24	25	26	27	28	29
SiO_2	34.06	34.80	34.95	39.90	35.92	35.23	34.63	34.42	37.87	34.47	36.87	35.21	35.79	36.89
TiO_2	2.58	2.70	3.16	2.06	2.68	2.41	3.52	3.34	3.02	2.40	2.35	2.85	2.18	2.35
Al_2O_3	16.67	13.47	12.82	14.91	14.37	15.55	13.80	16.24	15.84	15.64	15.89	15.52	21.42	20.24
Fe_2O_3	5.75	8.11	4.92	7.84	5.50	6.32	6.22	5.72	8.12	8.34	4.13	6.08	6.11	4.82
FeO	19.01	16.24	14.41	11.63	18.66	14.75	18.01	15.26	14.82	18.23	13.67	21.49	11.66	12.37
MnO	0.30	0.31	0.50	0.19	0.15	0.37	0.08	0.07	0.11	0.50	0.17	0.28	0.09	0.26
MgO	8.31	11.08	13.42	12.02	8.69	11.05	9.41	11.91	6.91	6.02	11.46	4.62	11.86	11.01
CaO	2.96	0.97	3.92	0.24	1.05	0.82	0.74	0.74	1.08	1.97	0.53	1.40	0.69	0.95
Na_2O	0.18	0.28	0.17	0.16	0.19	0.13	1.64	1.21	1.19	0.16	0.18	0.15	0.34	0.62
K_2O	8.03	8.64	5.90	9.71	8.70	9.20	8.20	6.70	7.83	8.30	9.90	8.25	7.82	8.45
H_2O^+	2.15	3.42	4.83	1.02	2.02	1.70	3.09	3.67	2.60	1.68	2.34	3.90	2.12	1.61
Total	100.00	100.02	99.00	99.68	97.93	97.53	99.34	99.28	99.39	97.71	97.49	99.75	100.08	99.57
Numbers of ions on the basis of 22(O) or 24(O.OH)														
Si	5.373	5.381	5.256	6.142	5.756	5.623	5.431	5.226	5.818	5.612	5.763	5.487	5.360	5.607
Ti	0.306	0.314	0.357	0.238	0.323	0.289	0.415	0.381	0.349	0.294	0.276	0.334	0.245	0.269
Al	3.099	2.455	2.272	2.705	2.714	2.925	2.550	2.906	2.868	3.001	2.927	2.850	3.781	3.626
Fe3+	0.683	0.944	0.557	0.908	0.663	0.759	0.734	0.653	0.939	1.022	0.486	0.713	0.688	0.551
Fe2+	2.508	2.100	1.812	1.497	2.501	1.969	2.362	1.937	1.904	2.482	1.787	2.800	1.460	1.572
Mn	0.040	0.041	0.064	0.025	0.020	0.050	0.011	0.009	0.014	0.069	0.023	0.037	0.011	0.033
Mg	1.954	2.554	3.008	2.758	2.076	2.629	2.199	2.695	1.582	1.461	2.670	1.073	2.647	2.494
Ca	0.500	0.161	0.632	0.040	0.180	0.140	0.124	0.120	0.178	0.344	0.089	0.234	0.111	0.155
Na	0.055	0.084	0.049	0.048	0.059	0.040	0.499	0.356	0.354	0.051	0.054	0.045	0.099	0.183
K	1.616	1.704	1.132	1.907	1.778	1.873	1.640	1.298	1.535	1.724	1.974	1.640	1.494	1.638
OH	2.262	3.527	4.845	1.047	2.159	1.810	3.232	3.717	2.664	1.824	2.440	4.054	2.118	1.632
ΣCAT	16.134	15.736	15.139	16.266	16.070	16.297	15.965	15.582	15.541	16.058	16.048	15.213	15.897	16.129
mg:	43.800	54.870	62.410	64.820	45.350	57.190	48.220	58.180	45.390	37.050	59.910	27.700	64.460	61.340
Al4	2.627	2.455	2.272	1.858	2.244	2.377	2.550	2.774	2.182	2.388	2.237	2.513	2.640	2.393
Al6	0.472	-	-	0.847	0.470	0.548	-	0.131	0.686	0.613	0.690	0.337	1.141	1.233
Fe3T	-	0.164	0.472	-	-	-	0.019	-	-	-	-	-	-	-
Z site:	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000	8.000
Y site:	5.963	5.787	5.326	6.273	6.053	6.244	5.702	5.808	5.474	5.940	5.931	5.294	6.194	6.153
X site:	2.171	1.949	1.813	1.994	2.018	2.053	2.263	1.774	2.067	2.118	2.117	1.919	1.703	1.976

1. Tribeč (quartz diorite); **2.** Tribeč (granodiorite); **3.** Tribeč (granodiorite); **4.** Tribeč (quartz diorite); **5.** Žiar (granodiorite); **6.** Nízke Tatry (biotite granodiorite); **7.** Nízke Tatry (granite); **8.** Nízké Tatry (granite); **9.** Nízke Tatry (granite); **10.** Nízke Tatry (granodiorite); **11.** Nízke Tatry (granodiorite); **12.** Nízke Tatry (granodiorite); **13.** Nízke Tatry (granodiorite); **14.** Nízke Tatry (granite); **15.** Nízké Tatry (granite); **16.** Vysoke Tatry (granite); **17.** Vysoke Tatry (granite); **18.** Vysoke Tatry (granite); **19.** Veporic unit (biotite tonalite); **20.** Veporic unit (biotite granodiorite); **21.** Veporic unit (biotite granodiorite); **22.** Veporic unit (biotite granodiorite); **23.** Veporic unit (biotite tonalite); **24.** Veporic unit (biotite granite); **25.** Veporic unit (biotite granite); **26.** Veporic unit (biotite tonalite); **27.** Veporic unit (granite); **28.** Veporic unit (granodiorite); **29.** Veporic unit (granodiorite).

All wet chemical analyses

References: Ďurkovičová (1967) 1, 3, 4, 5, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 27, 28, 29
Petrík (1980) 2, 6, 19, 20, 21, 22, 23, 24, 25, 26

Table 7. Biotite compositions of granitoids from Western Carpathian Plutonic Complex (Outer -zone).

	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
SiO_2	35.77	36,02	34.89	34,88	35.02	35,23	34,97	33.37	34.82	34,87	34.67	35.92	32,50	34,93	35.42	35.68	35,71	36,30
TiO_2	3,49	2.16	3,26	3.25	2,88	3.83	2.59	3,65	3,20	2.45	3.15	3,05	2.60	2.80	3.25	3,60	2.40	2.85
Al_2O_3	16.55	18.76	17.92	15.66	20.03	14.18	18,28	14.59	18,81	16,88	14,53	15.56	15.76	16,86	11.84	16.14	13,45	16,04
Fe_2O_3	6,91	8.71	6,76	5,72	3,90	7,95	5.44	8,14	3,32	5.49	7.56	5,18	6.95	5.58	7.56	3.27	5,12	4.83
FeO	16.49	13,30	15,92	19.28	18,39	16.54	19.13	19.26	17.15	19.11	17.97	17,97	19.26	17.25	19,41	16,15	18.93	15,85
MnO	0,48	0,54	0.46	0,56	0.56	0,36	0.21	0.24	0,28	0.34	0.40	0.56	0,60	0,55	0.28	0.73	0,23	0,27
MgO	6.98	6.42	6,79	5.89	5.50	9,49	6.83	6.35	9.70	7.96	8.43	8,29	9.19	8.81	8,73	7.46	9.56	10,32
CaO	0.89	0,86	1.94	0.41	0.62	0.75	0,34	0.66	0,70	0.87	0,73	0.63	0,89	0,50	1.01	3.34	0,87	1.01
Na_2O	0,31	0.25	0,30	0,08	0,08	0.08	1,15	0,16	0.20	0.18	0.16	0,16	0.12	0.10	0.10	0,63	0.08	0.12
K_2O	8.30	8,60	7,52	8.40	9.00	7.30	7,12	8.92	8.60	8,20	8,20	7.60	8,00	7.80	8,00	7.61	8.20	8,10
H_2O^+	1,28	2.26	2.36	3,58	3.66	3,24	3.29	4.15	2,79	3,71	3,31	3.40	4,06	3,37	3.45	3.12	3,21	3,00
Total	97.45	97,88	98,12	97,71	99.64	98,95	99.35	99.49	99.57	100.06	99,11	98.32	99,93	98.55	99,05	97.73	97.76	98,69
Numbers of ions on the basis of 22(O) or 24(O.OH)																		
Si	5,751	5,627	5.478	5,508	5.356	5,459	5.392	5,221	5,349	5,354	5.423	5.574	5,044	5.407	5.576	5,572	5.646	5.587
Ti	0.422	0,254	0,385	0,386	0,331	0.446	0,300	0,429	0,370	0.283	0,370	0,356	0.303	0,326	0,385	0,423	0,285	0,330
Al	3,136	3,454	3.316	2,914	3.610	2,589	3.322	2.691	3,406	3,055	2.678	2.846	2,883	3,076	2.197	2,970	2.506	2,910
Fe^{3+}	0,836	1,024	0,799	0,680	0,449	0.927	0,631	0,958	0,384	0,634	0,890	0,605	0,812	0,650	0,896	0,384	0,609	0,559
Fe^{2+}	2,217	1,738	2.090	2,546	2,352	2.143	2,467	2.520	2.203	2.454	2,351	2,332	2.500	2,233	2.555	2.109	2,503	2,040
Mn	0,065	0.071	0.061	0,075	0.072	0,047	0.027	0,032	0,036	0,044	0.053	0.074	0,079	0,072	0,037	0,097	0.031	0,035
Mg	1.673	1,495	1,589	1.386	1,254	2.192	1,570	1,481	2.221	1.822	1,965	1,917	2.126	2,033	2,048	1.736	2.253	2.368
Ca	0,153	0,144	0,326	0,069	0.101	0,124	0.056	0,111	0.115	0,143	0.122	0.105	0,148	0,083	0.170	0.559	0,147	0,167
Na	0.097	0,076	0,091	0.024	0,024	0.024	0.344	0,049	0.060	0.054	0,049	0,048	0.036	0,030	0,031	0,191	0.024	0,036
K	1,702	1,714	1.506	1,692	1,756	1,443	1,401	1.780	1.685	1,606	1.636	1.504	1,584	1,540	1,606	1.516	1,654	1,590
OH	1.373	2.355	2,472	3,771	3.734	3.349	3.384	4,332	2,859	3.800	3.454	3,519	4.203	3,480	3,622	3,250	3.385	3.080
ΣCAT	16,053	15,596	15,642	15,281	15.306	15,395	15.510	15,273	15,829	15,448	15.537	15.361	15,513	15,449	15.500	15.556	15.658	15,621
mg:	43.000	46.240	43.190	35.260	34,770	50.560	38,890	37.020	50.200	42.610	45.540	45.120	45.960	47,660	44,490	45.150	47.370	53.710
Al4	2,249	2.373	2.522	2,492	2.644	2,541	2.608	2,691	2,651	2.646	2.577	2,426	2,883	2,593	2.197	2,428	2.354	2.413
Al6	0.887	1,081	0,794	0.422	0,966	0.048	0,714	-	0,755	0.409	0,101	0,420	-	0.483	-	0,542	0.152	0,497
Fe3T	-	-	-	-	-	-	-	0,088	-	-	-	-	0.074	-	0.228	-	-	-
Z site:	8,000	8,000	8.000	8,000	8,000	8.000	8,000	8.000	8.000	8,000	8,000	8,000	8.000	8,000	8,000	8.000	8,000	8,000
Y site:	6,101	5.663	5,718	5,495	5,425	5.804	5,710	5,333	5,969	5,645	5,731	5,703	5,746	5.796	5,693	5.291	5.832	5.829
X site:	1,952	1,933	1.924	1.786	1,881	1.591	1,800	1,940	1.860	1.803	1,807	1,657	1.768	1,653	1,807	2.265	1.826	1,793

30. Malé Karpaty (biotite granodiorite); **31.** Malé Karpaty (biotite muscovite granodiorite); **32.** Malé Karpaty (biotite muscovite granodiorite); **33.** Malé Karpaty (granodiorite); **34.** Malé Karpaty (granodiorite); **35.** Povážský Inovec (granodiorite); **36.** Povážský Inovec (granodiorite); **37.** Povážský Inovec (granodiorite); **38.** Považský Inovec (granodiorite); **39.** Strážovské vrchy (granodiorite); **40.** Strážovské vrchy (granodiorite); **41.** Velká Fatra (granodiorite); **42.** Velká Fatra (granite); **43.** Branisko (granodiorite); **44.** Branisko (granite); **45.** Branisko (granodiorite); **46.** Branisko (quartz diorite); **47.** Branisko (quartz diorite).

All wet chemical analyses

References: Ďurkovičová (1967): 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47

Petrik (1980): 30, 31, 32

Table 8. Biotite compositions of granite, microgranite and pegmatite from Velence Mts. (Pelsonian Terrane).

	1*	2*	3*	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
SiO_2	33,70	36,70	36.38	36.38	35,47	35.50	35.10	35.64	36.39	36,48	35.89	35,27	35.74	35.71	36.34	36,26	36.51	35.46	36.51
TiO_2	4.37	3,57	2,39	0.02	0.03	2.36	3,91	3.53	0,00	0.05	0,00	2.62	2.30	2,81	0.40	0.69	1,31	3.17	1,09
Al_2O_3	14.09	13.30	17,43	12.91	13.48	13.00	12.79	13.16	12.51	11,94	11.79	12.61	12,72	12.67	12.31	14,42	12.35	12.89	12.28
Fe_2O_3	3.80	1,50	12,64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
FeO	24.63	24.10	15.50	31.35	31.22	29.49	29.62	29.29	32.42	31,65	33.13	29.61	29.78	29.71	29.33	29,33	29.54	30,36	29.90
MnO	0.63	0.50	1.46	0.45	0.40	0.56	0.56	0.55	0.82	0.80	0,85	0.58	0.55	0.57	0.54	0.53	0.51	0.50	0,55
MgO	5.71	6.68	1,08	6.23	6.61	6.14	5.29	5.41	5,97	6.15	5.96	5.96	5.94	5,91	7,27	7.38	6,84	5.47	6,94
CaO	1.09	1,12	0.91	0.04	0.07	0,00	0.00	0,00	0.00	0.00	0.00	0.00	0,00	0.00	0.00	0,00	0.00	0.00	0,00
Na_2O	0.25	0.12	0,12	0.18	0.19	0,09	0,28	0.23	0,10	0.09	0,07	0,23	0.25	0,27	0.24	0.21	0,18	0.17	0,18
K_2O	6,80	7.78	7.40	8.11	8.23	9.14	9,04	9,08	8.50	8,79	8.79	8.97	8,92	8.98	8.79	8,74	8.87	8.68	8,82
H_2O^+	4.48	3,99	4,29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cl	0.38	0.00	0.33	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total	99.93	99,36	99.93	95.67	95,70	96.28	96.59	96,89	96,71	95.95	96.48	95.85	96.20	96.63	95.22	97,56	96,11	96.70	96,27
								Numbers of ions on the basis of 22(O) or 24(O.OH)											
		24 (O.OH)									22(O)								
Si	5,258	5.716	5.538	5,847	5.712	5,670	5.601	5.645	5,839	5,895	5,823	5,670	5.715	5,686	5.848	5.665	5,821	5.647	5.821
Ti	0,513	0,418	0.274	0.002	0,004	0.283	0,465	0.420	-	0.006	-	0.317	0,276	0.336	0,048	0.081	0.157	0,380	0,131
Al	2,591	2.441	3,127	2,445	2.558	2.447	2.405	2,457	2.365	2,274	2.254	2,389	2.397	2,378	2.335	2,655	2,321	2,419	2.307
Fe^{3+}	0,446	0,176	1.448	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fe^{2+}	3.214	3.139	1,973	4,214	4.204	3,939	3,953	3.880	4,350	4.277	4,495	3,981	3,982	3,956	3.947	3,832	3.939	4,043	3,987
Mn	0,083	0.066	0.188	0,061	0.054	0,076	0,076	0,074	0,111	0,109	0.117	0,079	0,074	0.077	0,074	0.070	0,069	0,067	0.074
Mg	1.328	1,551	0,245	1,492	1,586	1.462	1.258	1,277	1.428	1,481	1,441	1.428	1.416	1,403	1,744	1,719	1.625	1,298	1,649
Ca	0,182	0,187	0,148	0,007	0,012	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Na	0.076	0,036	0,035	0,056	0,059	0.028	0,087	0,071	0,031	0.028	0,022	0,072	0,078	0,083	0,075	0,064	0.056	0,052	0,056
K	1,353	1,546	1.437	1,663	1.691	1,862	1.840	1.835	1,740	1,812	1.819	1,839	1.819	1.824	1,804	1.742	1,804	1,763	1.794
OH	4,662	4,145	4.357	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cl	0.100	-	0.085	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ΣCAT	15.144	15.275	14,500	15.787	15.880	15,767	15.690	15.658	15.864	15.882	15,971	15.774	15.758	15,742	15.875	15,828	15.791	15,671	15.819
mg:	29.230	33.070	11.010	26,150	27.390	27,070	24,140	24,770	24,700	25.720	24,270	26,400	26.220	26,170	30.640	30,950	29.210	24,300	29.260
Al4	2,591	2,284	2,462	2,153	2,288	2.330	2,399	2,355	2.161	2,105	2,177	2.330	2,285	2,314	2.152	2,335	2.179	2,353	2,179
Al6	-	0.157	0,666	0,292	0,270	0,117	0,007	0,102	0.204	0,168	0,077	0,059	0.112	0,063	0,183	0.321	0,141	0,066	0.129
Fe3T	0,151	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Z site:	8,000	8,000	8.000	8,000	8,000	8.000	8,000	8.000	8,000	8,000	8,000	8,000	8.000	8.000	8,000	8,000	8,000	8,000	8.000
Y site:	5.432	5,507	4,794	6.062	6,118	5.877	5,763	5.753	6.093	6,042	6,130	5.863	5,861	5,835	5.996	6,023	5.931	5,855	5,969
X site:	1,611	1.769	1,621	1,725	1.762	1.890	1,927	1.905	1.771	1,840	1,841	1,911	1.897	1,907	1.879	1,806	1.860	1,816	1.849

1. Sukoró quarry (biotite monzogranite); **2.** Székesfehérvári No.4. core sample 57.8 m (biotite monzogranite); **3.** Székesfehérvári quarry (microgranite); **4-19.** Rigó Hill quarry (fayalite content pegmatit).
*wet chemical analyses, not marked: electron microprobe analyses