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GEOCHEMISTRY OF THE ŽELEZNÉ HORY PLUTON (EASTERN BOHEMIA)

(Tabs. 2)

Abstract: The authors have studied chemical variations in the granitoids and gabbroids of the Nasavrky massif, situated in the south-eastern part of the Železné hory Hills (eastern Bohemia). For comparison with the granites of this massif they also discuss some petrochemical data on the biotite granite which is the predominant rock of the Chvaletice massif located in the north-western part of the Železné hory Hills. According to the recent regional division of the Bohemian massif the Nasavrky and Chvaletice massifs constitute a common unit — the Železné hory pluton.

Geochemical trends confirm that the magmatites of the Nasavrky massif do not constitute one continuous evolution series. The crystallization history of the massif is complicated even within individual magmatic formations. Close genetic relationships may only be postulated between some granodiorites of the central part of the Nasavrky massif and the granites of the volcano-plutonic Křižanovice Formation.

Резюме: Авторы изучали вещественные вариации в гранитоидных и габброидных горных породах Насаврцкого массива ю.—в. части Железных гор. С целью сравнения с гранитами этого массива обсуждались также некоторые петрохимические данные биотитического гранита, являющегося преобладающей породой Хвалетицкого массива в с.—з. части Железных гор. Согласно последнему региональному разделению Чешского массива, Насаврцкий и Хвалетицкий массивы образуют общее тело — Железногорский плутон.

Геохимические тренды подтверждают, что магматиты Насаврцкого массива не представляют собой один непрерывный эволюционный ряд. История кристаллизации плутона сложна даже в рамках отдельных магматических формаций. Более тесные генетические отношения можно предполагать только между некоторыми гранодиоритами центральной части Насаврцкого массива и гранитоидной Кржижановской формацией, которая считается самой молодой единицей варисского тектономагматического цикла.

The authors have studied chemical variations in the magmatites of the Železné hory pluton in eastern Bohemia. The pluton comprises the Chvaletice massif in the north—western part of the Železné hory Hills and the Nasavrky massif in their south-eastern part. The Chvaletice massif consists of pinkish biotite granite, in which minor bodies of gabbroid intrusives are emplaced.

The composition of the Nasavrky massif is very heterogeneous for which the complicated magmatic and metamorphic history is responsible. The predominant type in the northern part of the massif is the leucocratic Křižanovice biotite K-granite. It is pinkish-grey to reddish in colour, of highly varying texture

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and presumably passes eastwards into volcanogenic rocks of rhyolitic and rhyodacitic composition. In the southern part of the massif there is a subvolcanic complex of the leucocratic Všeradov albite granite which grades into albite quartz porphyry. Effusive derivatives of the Všeradov granite are the quartz keratophyre and quartz-free keratophyre of the neighbouring volcano-sedimentary Vítanov Formation. On the basis of the geological investigations the rocks of the volcano-plutonic Všeradov Formation are placed in the late Cadomian magmatic cycle and those of the Křižanovice Formation in the later phases of the Variscan tectono-magmatic cycle. (V a c h t l, 1979).

The granitoids (granodiorite, tonalite to quartz diorite) in the central part of the Nasavrky massif show a considerable variability both in chemistry and texture. Besides the rocks with granitic texture, in some parts there are rock types with a more or less distinct plane parallel texture. These were produced by hybridization, granitization and migmatization of supracrustal sedimentary and volcano-sedimentary complexes. Gabbroes and diorites forming large and minor bodies throughout the Nasavrky massif are also of varied composition. A part of them are intrusives but the by far predominant part represent recrystallized relics of the metabasites that formed the mantle of the massif (K n o t e k, 1976).

Consistent with the wide spectrum of petrographic rock types ranging from the pyroxene—hornblende gabbro to leucocratic granite is the considerable variation in the contents of most of the petrogenic elements. The distribution of some minor and trace elements and their relationship to the bulk composition have been studied on a set of 90 samples, and the individual magmatic formations were compared on the basis of chemical variations. Although the set of samples was incomplete and all the analytical data were not of the same value, the following regularities could be derived from the results:

The accumulation of most microelements in the rocks of the Železné hory pluton is relatively small. They are most deficient in the granitoids of the volcano-plutonic Všeradov Formation.

The granites of the Chvaletice massif show the highest chemical homogeneity. A characteristic feature is the presence of ore elements Cu, Pb, Cr and Ni to the detriment of typical lithophile elements that have been discriminated in the rocks.

The macro- and microchemical composition of the granitoids of the volcano-plutonic Křižanovice Formation is more varying. The high Ba concentrations, increased Cr and Ni, and a considerable variation of most of the petrogenic elements are typical of this unit. The overall distribution of elements indicates that these rocks were forming within a relatively broad interval of temperatures and pressures and very likely during several phases. Their polyphasal development and subvolcanic character have also been inferred by V a c h t l (1975) from their textural variability, and by C h l u p á č o v á et al. (1977) from the inhomogeneous distribution of Th and from the differences in the U and K contents.

An extreme geochemical inhomogeneity has been assessed for the volcano-plutonic Všeradov Formation in the southern part of the Nasavrky massif. The albite granite, albite quartz—porphyry and keratophyre of this unit do not contain any of the minor and trace elements studied. We presume that the primary composition of this old magmatic association had been substantially

Table 1
Mean chemical composition (wt. %) of the magmatites in the Železné hory pluton (Eastern Bohemia)

	Nasavrky massif					Chvaletice massif
	albite* granite	biotite* granite	granodiorite, tonalite	basic rocks		biotite granite
	Všeradov type	Křižanovice type	central part of the massif	diorite	gabbro	Chvaletice type
	n = 9	n = 6	n = 12	n = 7	n = 11	n = 4
SiO_2	77.32	74.68	64.79	51.64	46.31	75.21
TiO_2	0.15	0.23	0.56	1.11	0.98	0.16
Al_2O_3	12.63	12.77	16.13	17.34	18.86	12.74
Fe_2O_3	1.50	1.75	1.81	3.99	5.34	1.04
FeO	0.34	0.44	3.26	5.40	5.22	1.01
MnO	0.05	0.04	0.08	0.19	0.23	0.03
MgO	0.32	0.58	2.14	4.96	5.88	0.63
CaO	1.24	1.22	3.43	9.13	11.91	1.08
Na_2O	5.24	2.88	3.79	3.35	1.95	3.59
K_2O	0.34	3.59	3.37	0.88	0.55	3.63
P_2O_5	0.10	0.07	0.19	0.21	0.27	0.05
H_2O^+	0.75	0.92	0.69	0.93	1.30	0.47
H_2O^-	0.24	0.21	0.12	0.19	0.26	0.23

n ..... the number of samples
* ..... with their effusive derivates

altered during the postmagmatic stage (V a c h t l, 1972, 1975). The escape of some mobile elements might have been caused by metamorphic processes of a high intensity. The Všeradov granite also agrees with the pre-Variscan granites of the Bohemian Massif in the sub-clarke contents of the radioactive elements (C h l u p á č o v á et al., 1977).

The volcanic equivalents of both the chief granite types of the Nasavrky massif have nearly identical chemical properties with those of the plutonic (or subvolcanic) members. The only essential difference is in the values of the solidification index which indicates an earlier origin of the volcanites (V a c h t l, 1971, 1972; F i a l a, 1978).

The granodioritic and tonalitic rocks in the central part of the Nasavrky massif appear to be the main carriers of microelements; this would point to the anatectic origin and contamination by rocks of the original mantle of the massif. Information analytical tests indicate an accumulation of Ba, Rb, Pb, Sn, Ni and particularly of Cr, whose average content exceeds the clarke by almost one order of magnitude.

The basic rocks of the Nasavrky massif are characterized by a moderately increased content of Mn, V and Li. The distribution of Ni, Cr and Li shows the greatest anomalies; it is quite atypical of the gabbroid rocks and corresponds

Table 2
Mean trace element contents (ppm) of the magmatites in the Železné hory pluton (Eastern Bohemia)

	Nasavrky massif					Chvaletice massif
	albite* granite	biotite* granite	granodiorite, tonalite	basic rocks		biotite granite
	Všeradov type	Křižanovice type	central part of the massif	diorite	gabbro	Chvaletice type
	n = 7	n = 24	n = 36	n = 7	n = 11	n = 7
Ba	480	1494	740	438	76	355
Sr	249	198	488	583	272	106
Rb	182	154	193	55	45	144
Li	11	20	31	44	49	22
B	—	20	17	—	—	—
Ga	—	15	—	—	—	15
Y	—	20	17	—	—	—
Nb	—	20	20	—	—	—
Zr	—	127	—	—	—	—
U**	1.9	3.9	6.6	2.1	0.8	6.5
Th**	7.7	24.0	15.1	4.3	1.9	16.8
Cr	14	44	166	63	53	40
V	11	22	103	250	284	19
Ni	5	14	41	25	17	14
Zn	—	30	77	—	—	52
Cu	6	17	18	44	66	34
Pb	—	22	29	—	—	32
Sn	—	5	8	—	—	10

n ..... the number of samples
* ..... with their effusive derivates
** ..... calculated from Chlupáčová et al. (1977)

to that in the granites. The geochemical discontinuities combined with the results of petrological investigations provide evidence that these rocks are not of the same genesis.

Geochemical trends confirm that the magmatites of the Železné hory pluton do not constitute one continuous evolution series. The crystallization history of the pluton is complicated even within individual magmatic formations. Close genetic relationships may only be postulated between some granodiorites of the central part of the Nasavrky massif and the granites of the volcano-plutonic Křižanovice Formation.

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