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MICROELEMENTS Au, As, Sb, U, Th, W, Ta, Zr, Hf AND Sc IN THE WEST CARPATHIAN METABASITES

(Figs. 2, Tab. 9)

Abstract: In the presented work are summarized the results of geochemical studies of some metallic microelements (Au, As, Sb, U, Th, W, Ta, Zr, Hf, Sc) in metabasites from different mountains of the West Carpathians (Malé Karpaty, Inovec, Tribeč, Malá Magura, Malá Fatra, the Low Tatras, the High Tatras, Spišsko-gemerské rudohorie, Veporide core Mts.)

Резюме: В приведенной работе подитожены результаты геохимического изучения некоторых металлических микроэлементов (Au, As, Sb, U, Th, W, Ta, Zr, Hf, Sc) в метабазитах из разных горных массивов Западных Карпат (Малые Карпаты, Иновец, Трибеч, Малая Магура, Малая Фатра, Низкие Татры, Высокие Татры, Спишско-гемерское рудогорье, вепоридное кристалликикум). В таблицах приводятся арифметические и геометрические средние содержаний отдельных микроэлементов. Установлено значительное согласие содержаний микроэлементов из отдельных горных массивов и авторы определили что у некоторых элементов в процессе метаморфоза происходит повторное распределение их содержаний (U, Au, Sb, As).

Анализы пород осуществили методом неутроновой активации и авторы установили что часть аналитических результатов, полученных этим методом кажутся быть перевышенными (W) и у части, в сравнении с содержаниями приводимыми в литературе, содержания пониженные (Ta).

Arithmetical and geometrical means of the contents of the individual microelements are given in the tables. A considerable agreement of microelement contents from the individual mountains was established and the authors have found that in some elements, in the process of metamorphosis, redistribution of their contents takes place (U, Au, Sb, As).

The rock analyses were carried out by the method of neutron activation and the authors have established that one part of analytical results, received by this method seems to be exceeded (W) and one part has their contents reduced in comparison with contents, given in literature (Ta).

There are elements which, in our contry, were analyzed very rarely in basic rocks and it can be said that our data are ones of the first kind and it is why the results cannot be compared. As there are among the published elements also those of great economic and metallogenous importance, their geochemical and Clark evaluation is of extraordinary importance. For example, in the area of the Malé Karpaty Mts., but also in the other mountain ranges, there occur deposits or at least indications of pyrite ores (pyrite formations) in the zone of metabasites accompanied also by other metals as for instance antimon, arsenic, gold, etc. It is why the determination of contents of the

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mentioned elements in metabasites forms also part of our research program. It may help to explain the genesis of mineralization, as well as to point to the possible primary ore resources which is a serious metallogeneous problem.

Tables of original content values of metallic elements in the West Carpathian metabasites are given in Tables 1/a, b, c, d, e) and in Table 2. These tables are set up according to regional criteria. Analyses refer to the same samples. Their documentation is given in the paper by Cambel — Martiny — Spišiak (1979) dealing with the alcaline microelements. Rare — earths in identical samples were evaluated by the authors in a special paper by Cambel — Spišiak (1979). Table 2 contains arithmetic and geometric mean contents of elements according to individual mountain ranges. There are given also other statistical data, the original tables (1 and 2) set up by the authors comprise also the contents of scandium and copper. The Sc values are given because the same samples were analyzed on scandium spectrochemically and by means of neutron activation. The comparison of data we considered as important from the methodical view point, but also from the geochemical one, because the scandium is a significant element enabling the determination mainly of thermic conditions of the occurrence of minerals. The copper clarks in metabasites of tatroveporides are given for comparison with the other metalic elements. Examples of contents of studied elements taken from the literature enable to compare the values in analogous rocks abroad. They are Tables 3 to 8.

From the values of contents of elements we set up the histogram in Fig. 1/a, b), in which the analyses of samples from individual mountain ranges have a particular hatch, and thus it is possible from the regional view point to follow the content distribution of elements in the histogram intervals. The below the limit values of contents of elements are indicated by oblique hatch in the histogram. By using the method of neutron activation the detectability limit for individual elements is the following (in g/t): As = 0.01; As = 1.5; Sb = 0.25; U =0.5; Th = 0.1; W = 1.5 and Ta = 0.02.

Gold

Gold belongs to are metals; their contents vary in meteoric materials, but they are very small. Ščerbakov — Perežogin (1964) (in Polanski — Smulikowski, 1969, Tab. 153) give the following gold values in g/t: ultrabasic rocks 0.0094 (n=27), basic rocks 0.0087 (n=62), intermediatry 0.004 (n=22), acid 0.0042 (n=55). From minerals the richest in gold is magnetite (0.048 g/t), medium contents have pyroxene, olivine and quartz, i.e. from 0.011 to 0.016 g/t. Further data with gold content are given in Tab. 3 and 4.

Data of gold contents in sulphides fluctuate considerably, because the monomineral fractions currently taken for the analysis were not thoroughly separated and controled for their purity. According to sulphide analysis results for gold its values range between thousandths to tenths of g/t Au in separated minerals. A heavy part of pyrite ores of the sedimentary pyrite formation from the area of Malé Karpaty Mts. amounts to 0.001 to 0.1 g/t of gold.

The gold geochemistry is not sufficiently investigated. Increased Au contents are in metallic meteorites as compared with other types of meteorites. The occurrence of gold in terrestrial rocks and minerals is more ore less

Table 1a

Malé Karpaty mts. — MK

Sample denotation	Au	As	Sb	U	Th	W	Ta	Zr	Hf	Sc	Ga	Cu
AM— 1. 10—MK	ND	69+	2.0	ND	ND	ND	ND	47	2.3	36/21	11	63
AM— 3. 10—MK	0.026	35	2.6	ND	0.45	13.0	ND	68	1.5	53/34	18	40
AM— 4. 10—MK	ND	ND	1.3	7.4+	ND	17.0	ND	36	1.5	48/35	17	68
AM— 5. 10—MK	ND	22	ND	ND	ND	11.5	ND	115	1.8	46/35	19	50
AM— 6. 10—MK	ND	ND	4.8	<1	ND	ND	ND	214	5.0	58/43	25	35
AM— 7. 1—MK	0.161	ND	—	ND	—	9.6	—	44	—	—/47	9	155
AM— 8. 1—MK	0.302	ND	ND	ND	ND	ND	ND	44	2.0	37/29	11	33
AM— 9. 10—MK	ND	<3	<0.5	10.5+	0.52	ND	ND	132	2.6	56/57	21	760+
AM—11. 10—MK	ND	8	—	ND	—	ND	—	63	—	—/45	19	83
AM—12. 10—MK	ND	72+	3,2	ND	2.2	8.1	0.07	269	3.9	30/27	20	104
AM—14. 10—MK	ND	ND	0.78	1.5	ND	13.5	ND	195	2.8	49/37	17	104
AM—40. 10—MK	0.145	73+	1,8	<1	ND	10.0	0.05	182	2.8	53/45	17	59
$\bar{x}$	0.06	24.1	1,75	1.99	0.49	7.52	0.03	117.4	2.62	47/36	17	129.50
$\bar{x}$+	0.04	8,3		0.6								72.18

Table 1 b

Inovec, Tribeč, Suchý, Malá Magura mts. — I, T., S., M.

Sample denotation	Au	As	Sb	U	Th	W	Ta	Zr	Hf	Sc	Sc	Cu
AM—38.13—T	0.042	ND	1.3	<1	0.16	9.7	ND	195	4.0	52/41	14	10
AM—39.13—T	0.307+	ND	1.2	ND	0.85	ND	ND	460	8.1	37/21	20	43
173.34.2—T	0.015	18	1.9	2.7	0.75	12.5	0.04	308	3.4	46/28	19	83
175.34.4—T	ND	44+	ND	1.3	ND	22	ND	218	2.6	42/48	18	43
115.17.1—M	0.041	9.4	1.2	1.3	4.4+	14.0	ND	73	4.5	39/32	19	36
$\bar{x}$	0.083	14.9	1.17	1.36	1.25	11.94	0.02	250.8	4.52	43/34	10	43
$\bar{x}$+	0.027	7.6			0.47							

Table 1c

Malá Fatra, Nízke Tatry, Vysoké Tatry mts. — M F, N T, V T

Sample denotation	Au	As	Sb	U	Th	W	Ta	Zr	Hf	Sc	Ga	Cu
133.24.3—MF	0.015	6.6	1.3	ND	1.8	22	ND	335	5.0	47/36	25	54
136.25.2—MF	0.049	ND	0.95	ND	0.75	9.6	0.04	300	5.5	26/19	25	50
AM—17.22—MF	0.025	ND	0.9	ND	2.9	ND	ND	83	1.9	40/35	15	48
188.37.1—NT	ND	ND	0.40	1.1	10+	5.0	0.08	188	3.6	68/48	33	26
AM—21.31—NT	ND	ND	0.75	ND	1.0	ND	0.10	98	2.4	48/31	17	79
148.29.2—VT	ND	ND	1.5	2.0	2.4	18.0	0.11	252	6.4	47/33	21	24
AM—15.29—VT	ND	24+	ND	1.6	ND	31+	ND	120	3.5	58/54	19	35
171.33.1—Branisko	ND	ND	1.9	ND	0.45	14.5	0.04	65	3.0	43/18	21	69
125.21.3—MF	0.026	32.0+	ND	ND	ND	31.0+	0.05	121	2.4	55/37	19	384+
144.28.1—VT	0.040	24+	ND	ND	ND	3	0.03	89	2.7	47/50	18	20
$\bar{x}$	0.02	9.56	0.85	0.82	1.96	13.7	0.05	165.1	3.64	48/36	21.3	78.9
$\bar{x}$+		2.23			1.07	9.39						45

Table 1d
VEPORIDES — VEP

Sample denotation	Au	As	Sb	U	Th	W	Ta	Zr	Hf	Sc	Ga	Cu
AM—18—VEP	ND	35+	ND	ND	ND	25+	0.06	72	2.8	51/34	18	16
AM—19—VEP	0.168	4.8	2.5	ND	0.68	ND	ND	89	2.5	54/50	22	107
AM—23—VEP	0.025	35+	0.70	ND	0.54	14.5	ND	20	1.5	50/45	7	26
AM—24—VEP	ND	ND	1.7	ND	0.52	13.5	ND	74	3.0	44/36	22	40
AM—25—VEP	0.018	ND	1.5	ND	ND	8.1	ND	85	2.0	47/36	16	95
AM—26—VEP	ND	ND	3.4	ND	1.7	ND	0.13	282	3.8	34/25	20	65
AM—27—VEP	0.186	3	2.0	7.6+	2.6	11	ND	102	2.7	57/45	8	13
196.47.2—VEP	0.018	ND	ND	1.7	0.78	16.0	0.16	51	3.4	51/44	23	111
202.48.6—VEP	0.040	2.8	1.3	1.5	ND	ND	ND	69	2.0	48/66	17	74
235.57.12—VEP	0.057	22+	ND	ND	4.8	11.0	0.06	257	6.2	35/27	16	19
304.75.5—VEP	ND	ND	0.78	1	ND	30.0	ND	93	2.0	48/31	18	73
305.75.6—VEP	0.022	ND	3.0	2.6	ND	15.0	0.05	49	2.1	40/25	13	34
x̄	0.047	9.3	1.47	1.49	1.01	12.4	0.05	103.5	2.83	46/37	16.67	56.08
x̄+		2.18		0.94		11.24						

Table 1e
Spišsko-gemerské rudohorie — SGR mts.

Sample denotaton	Au	As	Sb	U	Th	W	Ta	Zr	Hf	Sc	Ga	Cu
AM—29—SGR	ND	6.6	2.2	ND	ND	ND	ND	275	5.5	45/39	17	26
AM—30—SGR	ND	25	3.6	ND	ND	6.1	0.04	54	2.6	49/42	9	89
AM—31—SGR	ND	ND	—	17.5+	—	27+	—	24	—	—/14	18	38
AM—32—SGR	0.018	ND	0.9	ND	1.6	5.8	0.06	98	3.2	54/34	14	83
AM—34—SGR	ND	39+	0.7	2.7	4.5	9.1	0.18	309	7.5	36/26	22	13
x̄	0.012	14.72	1.85	4.34	1.66	9.9	0.08	152	4.7	46/31	16	49.8
x̄+		8.65		2.14		5.63						

Tables of orifinal values cf contents of elements of metabasites of the West Carpathians divided according to regional aspects.

Explanations Average values with a + 1 cross signify the calculations of averages with neglecting anomalous numbers in columns indicated also by a + cross. What regards scandium the numbers in the numerator are determined by neutron activation and in the denominator spectrochemically. Values are given in g/t. Tab. 1a, b, c, d, e.

accidental and relates to limited places, in parts of crystals of varied type. In sulphides it can easily increase from the basic level of 5 mg/t to 80 mg/t. Vincent and Crocket (1960 — in Taylor, 1965), assume the presence of CuAu alloy in sulphides, but Ag may be also the alloy element. Iron sulphides contain always more gold and less silver than sulphides rich in copper (Ščerbina, 1956, in Taylor, 1965), gold is currently connected with Te, Bi and Sb. Gold forms usually the fillings between the big ions of the lattice.

Recently, mainly in the USSR, a great number of rock analyses for gold content has been carried out. It was made possible mainly by the neutron activation. Gold contents in rocks are small and sometimes they are given also in mg/t. A table of content results of Au in core and mantle rocks was set up by Lutz (1975). On the basis of his work it has been shown that mantle xenolites of grenat periditites have low contents of gold in average 4.9 mg/t (0 0049 g/t) and eclogites 4.7 mg/t. There is deduced Au content in the mantle from 0.7 to 9.2 mg/t (average 4.9 mg/t), in chondrites the Au content is higher 170 mg/t (0.170 g/t) which corresponds with the presence of sulphide in chondrodites.

From Table 4 set up according to Lutz' Table (1975) it follows that the gold content in ultrabasic and basic rocks is similar to ultrabasites of the dunite—harzburgite formations and alpine-type ultrabasites. Thus the question arose, whether the mantle is not the primary bearer of ore and supplier of depotits. Numerous determinations of gold in mantle rocks have shown that various types of rocks of the mantle have monotonous and low contents of gold. Neither kimberlites or basalts contain more of it, which occur by melting mantle rocks. According to this approach it must be assumed that silicate melting is not gold enriched. Increased gold contents in crust rocks are not therefore of the primary mantle origin, but are conditioned by post-magnetic or metamorphous processes and by a younger sulphidization. It results also from the inequality of enrichment of crust rocks in gold. Neither the depth of magma occurrence (kimberlites, continental tholeiites and alcaline—olivine basalts), which have approximately similar contents of gold, do testify to the movement of gold in the melting process. Analyses of original minerals for gold content are also monotonous — and therefore we cannot speak of any minerals, concentrates of gold. It aplies also to secondary magnetites, pyrites and to other sulphidic minerals in rocks.

From the gold content histograms it can be seen that almost half of our data determined by means of neutron activation are below the limit (less than 0.01 g/t), in which the Little Carpathian metabasites have a high part. On the other hand again 3 samples in the mountain range have values in tenths of g/t of Au which, with regard to what precedes, is to be considered as an anomalous content and as an addational rocks enrichment in gold. What

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Tables of original values of contents of element of metabasites of the West Carpathians divided according to regional aspects.

Explanations Average values with a + (cross) signity the calculations of averages with neglecting anomalous numbers in columes indicated also by a + cross. What regards scandium the numbers in the numerator are determined by neutron activation and in the denominator spectrochemically. Values are given in g/t. Tab. 1a, b, c, d, e.

Table 2

Mountain ranges		Au	As	Sb	U	Th	W	Ta	Zr	Hf	Sc-1	Sc-2	Cu
MK n=10	A.p.	0.054	28.000	1.740	2.390	0.307	7.910	0.028	117.400	2.620	46.600	36.300	131.000
	s.v.	0.096	31.904	1.468	3.549	0.657	5.976	0.017	81.988	1.107	9.359	10.176	222.244
	v.k.	178.044	113.944	33.988	148.513	169.775	75.551	62.542	62.971	42.265	20.084	28.035	168.878
	G.p.	0.020	9.178	1.163	1.137	0.186	5.185	0.024	104.614	2.437	45.666	35.045	73.800
I.T.S.M. n=5	A.p.	0.083	14.880	1.170	1.360	1.252	11.940	0.024	250.800	4.520	43.200	34.000	43.000
	s.v.	0.126	17.647	0.591	0.817	1.791	7.412	0.000	143.900	2.122	5.974	10.653	26.322
	v.k.	151.890	118.601	50.528	60.096	143.119	62.080	37.267	57.379	46.968	13.830	31.334	60.844
	G.p.	0.030	6.995	0.976	1.179	0.537	8.905	0.022	213.120	4.108	42.880	32.637	35.356
MF, NT, VT, n=10	A.p.	0.020	9.560	0.845	0.820	1.960	13.710	0.051	165.100	3.640	47.900	36.100	78.900
	s.v.	0.014	12.106	0.580	0.557	2.996	11.504	0.033	97.850	1.503	11.179	12.077	108.955
	v.k.	69.453	126.637	38.691	67.972	152.861	83.916	66.300	59.267	41.304	23.339	33.457	138.068
	G.p.	0.016	4.113	0.656	0.698	0.728	8.418	0.041	141.654	3.383	46.605	34.080	50.976
VEP n=12	A.p.	0.047	9.300	-1.469	1.491	1.010	12.383	0.050	103.503	2.833	46.583	36.641	56.083
	s.v.	0.062	13.312	1.088	2.038	1.418	8.907	0.047	80.814	1.240	7.140	15.658	36.054
	v.k.	129.747	143.147	74.064	136.657	140.439	71.927	95.346	78.018	44.065	15.329	42.733	64.256
	G.p.	0.026	3.899	1.030	0.925	0.421	8.360	0.036	82.228	2.679	46.043	30.614	44.184

Mountain ranges		Au	As	Sb	U	Th	W	Ta	Zr		Sc-1	Sc-2	Cu
SGR n = 4	A.p.	0.014	31.075	1.537	2.225	0.187	10.750	0.020	66.500	3.221	45.750	31.250	55.200
	s.v.	0.008	28.332	1.009	3.450	0.175	6.589	0.000	34.952	1.510	7.135	6.849	12.605
	v.k.	57.142	88.006	65.654	155.056	93.333	61.294	0.000	52.559	46.893	15.596	21.910	22.959
	G.p.	0.012	16.801	1.140	0.980	0.145	7.857	0.020	60.311	45.650	45.304	30.581	54.302
TATRIDY n = 25	A.p.	0.046	18.00	1.271	1.556	1.189	11.036	0.036	168.280	3.365	46.440	35.760	92.800
	s.v.	0.082	23.705	1.079	2.340	2.140	8.911	0.026	107.657	1.621	9.421	10.642	155.919
	v.k.	177.450	131.697	84.922	150.389	179.955	80.745	73.065	63.974	40.179	20.286	27.762	168.016
	G.p.	0.021	6.305	0.893	0,942	0.397	7.013	0.030	136.161	3.051	45.463	34.166	54.949
TATRIDY + VEP.	A.p.	0.046	15.178	1.335	1,535	1.131	11.472	0.044	147.297	3.408	46.486	36.045	80.811
	s.v.	0.075	21.114	1.071	2.218	1.917	0.000	0.034	103.271	21.265	8.646	12.272	130.031
	v.k.	161106	139.111	80.210	144.507	169.409	76.775	85.152	70.110	1.747	18.599	34.045	160.746
	G. p.	0.022	5.395	0.936	0.405	7.424	0.031	115.615	2.940	0.377	45.650	32.971	51.221
TATRIDY + VEP. + SGR	A.p.	0.043	15.456	1.385	1.487	1.174	10.902	0.044	150.878	1.611	46.439	35.968	78.146
	s.v.	0.072	20.598	1.091	2.130	1.910	8.581	0.039	104.523	1.775	8.464	11.801	124.104
	v.k.	166.581	133.269	78.792	143.230	162.637	78.715	90.036	69.276	47.290	18.227	32.810	158.820
	G.p.	0.021	5.725	0.979	0.918	0.413	7.090	0.033	118.247	3.096	54.636	33.135	49.944

A summary table of arithmetical means (A. P.) of geometric menas (G. P.), standard deviations (s. v), variable coefficients (v. k.). In statistical treatment the contents below the limit (ND) were substituted by the following values: in g/t W = 1.5; Ta = 0.02;. The Zr, Sc, Cu contents were determined spectrochemically. Regarding scandium numbers in column Sc-2 were determined spectrochemically.

Table 3

	Th	U	Zr	Hf	Nb	Ta	Mo	W	As	Sb	Au
Chondrites	0.03	0.01	35	0.2	0.5	0.04	1.5	0.14	2	0.1	0.1
Crust	10	2.7	165	3	20	2	1.5	1.5	1.8	0.2	0.004
Ultrabazic	0.003	0.001	50	0.5	15	1	0.3	0.5	1	0.1	0.005
Basalt	2.2	0.6	150	2	20	0.5	1	1	2	0.2	0.004
Syenite	10	3	500	10	40	4	3	10	1	—	0.004
Granodiorite	10	3	140	2	20	2	1	2	2	0.2	0.004
Granite	17	4.8	180	4	20	3.5	2	2	1.5	0.2	0.004
Shale	12	4	160	3	20	2	3	2	15	1	0.004
Greywacke	10	3	140	2	20	2	—	2	2	0.2	0.004
Limestone	2	2	20	0.5	—	—	1	0.5	2.5	—	—
Quartzite	2	0.5	250	5	—	—	—	—	1	—	0.005
Soil	—	—	—	—	—	—	2	—	1—50	—	—

Abundances of Th, U, Zr, Hf, Nb, Ta, Mo, W, As, Sb, Au Data in ppm
Contents of microelements in various geological materials and rocks were set up from three tables of Taylor (1965—Tab. 15, 21, 22)

regards samples from the gemerides and the Inovec and Tribeč Mts. (I,T,S,M) it is similar. Samples from the other mountain ranges have more frequently contents in limits between 0.01 and 0.05 g/t.. In the table of average values of contents of Au (Tab. 2) for more directive, what regards gold, it is necessary to consider the geometric means rather than the arithmetic ones, because the latter are more influenced by anomalous secondary enrichment of rocks in gold which occurs frequently in the West Carpathian metamorphites. Then it is possible to state that gold contents in metabasites of individual mounatin ranges range within the average from 0.012 to 0.03 g/t of Au. The real Au content value, however, can be lower, because the calculations comprised the below-limit contents ($<0\ 01$ g/t) as values of 0.01 g/t which need not correspond to the reality, because they may be lower values. Therefore based on similar calculation of averages the results may be exceeded, mainly when we compare them with the data in the foreign literature. It can be seen mainly when comparing gold contents in tholeiites (see Tab. 4.). Gold contents in metabasites of the tatroveporides approach more likely values which are characteristic for the alcaline olivine tholeiites (or basalts). As against the data in Tab. 3 the gold content values in metabasites of the West Carpathians are also exceeded.

Fig. 1a, Content histograms of metallic elements in metabasites of the West Carpathians. Analyses are divided by hatching according to individual mountain ranges. Columns hatched in oblique represent analyses, having contents of elements which are below limit of their analytical determinability. The limit values are written above the columns of the histogram. The same values were used as real numbers in the calculation of statistical characteristics.

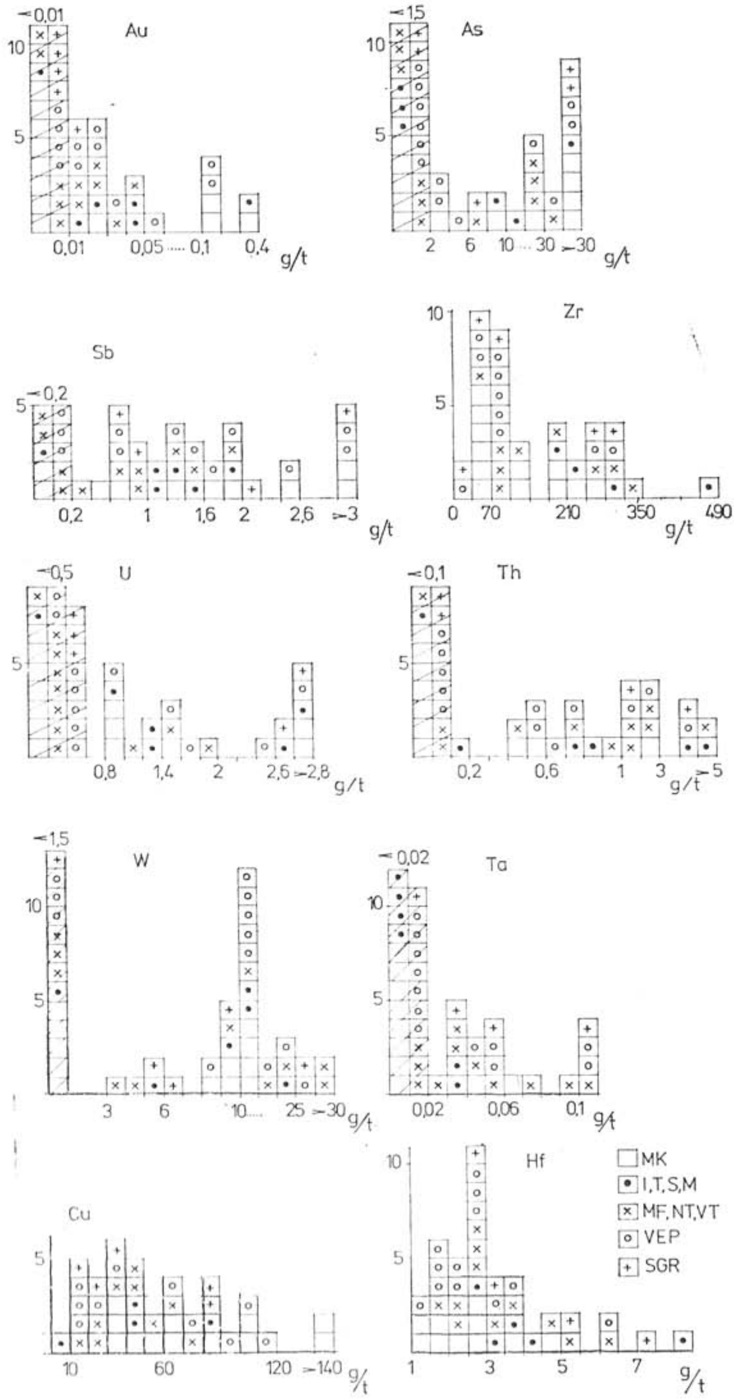
Au
As
Sb
Zr
U
Th
W
Ta
Cu
Hf
g/t
MK
I, T, S, M
MF, NT, VT
VEP
SGR

Table 4

Member	Oceanic tholeiite	Continental tholeiite	Alkali-olivinic tholeiite	Potassium basalt	Kimberlite
Ti	8100	10900	17900	4700	11500
Zr	90	130	285	175	310
Hf	2	2	3.5	—	—
Nb	—	5.4	61.0	39.7	98.4
Ta	—	0.5	5.0	3.6	6.4
Ti/Zr	90	80	62	27	37
Nb/Ta	—	12	12	11	17
Th	0.18	0.4	4.61	40.0	21.3
U	0.10	0.2	1.14	6.0	1.9
Th/U	1.8	2.0	4.0	6.6	11.0
K/U	1.4×10^4	4.2×10^4	1.0×10^4	1.0×10^4	0.6×10^4
Au (mg/t)	0.00077	0.004	0.1	0.0063	0.0042

Table of contents of Ti, Zr, Hf, Nb, Ta, Th, U, Au elements in various basaltic rocks according to Lutz (1975 — Tab. 56, p. 124—126).

Antimon and arsenic

The geochemistry of antimon is not thoroughly investigated, because it is an element with small contents in geological materials and there are difficulties to determine this element analytically. Our results were obtained by neutron activation in the laboratories of uranium industry.

The most detailed study on the antimon and arsenic contents was presented by Onishi and Sandell (1955). See Tab. 5. According to these authors the Sb content in chondrites is approximately 0.1 g/t and in the metallic phase of meteorites 0.5 g/t. The antimon content in rocks does not substantially change in magmatic rocks not even dependently on the SiO_2 content. The ultrabasites have 0.1 g/t and granites 0.24 g/t of Sb. Most frequent Sb contents in the upper crust rocks are between 0.1 to 0.2 g/t and the Sb/As ratio is 0.1. From the sediments the richest in arsenic and antimon are the iron ores, phosphates and bauxites, as well as dark shales. The Sb contents in sediments are higher and range within 0.1 and 4 g/t.

The antimon is considerably enriched in the weathering products above the rocks and attains the value of 2.3 to 9.5 g/t (Ward and Laskin, 1954). Boyle (1965) determined in the weathering products of rocks not influenced by mineralization 1 to 3 g/t of Sb and 16 g/t of arsenic. The Sb/As ratio gives the value of 0.1.

The magmatic rocks in general have contents from 0.1 to 0.9 g/t. Onishi — Sandell (1955) give the following averages of As for magmatic rocks (in g/t):

siliceous rocks rhyolites — felsites (16 an) 3.5 ± 0.5 glasses. (12 an) 5.9 ± 0 9; granitic rocks (63 an) 1.4; granitic rocks (50 an) 1.7 ± 0.3; intermediary rocks (36 an) 2.4 ± 0.4; basalts and diabases (40 an) 1.9 ± 0.3; basic flows — Michigan (12 an) 2.4; gabros (31 an) 1.4 ± 2; peridotites and dunites (19 an) 1.0 ± 0.2; serpentinites (10 an) 2.8.

Data on As and Sb contents are in Tab. 3 and 5.

Table 5

Name	Sb	As	Sb/As
basalts and diabases, mainly North America n = 11	0.3		
basalts and diabases, mainly USA n = 6	0.9	2.6	0.4
basalts and diabases, Minesota and Wisconsin, n = 5	0.1	1.0	∾0.1
basalts, Michigan n = 12	0.1	0.8	∾0.1
basalts, Michigan n = 8	0.1	1.6	<0.1
olivinic basalts, Oregon USA n = 7	0.1	0.8	∾0.1
basalts and diabases, Japan n = 5	1.4	2.0	0.7
gabbros, USA and Canada n = 4	0.2	2.1	∾0.1
gabbros, Minesota n = 5	0.1	0.9	0.1
ultrabasites, USA and Canada n = 13	0.1		
ultrabasites, USA n = 4	0.2	0.9	∾0.1

Table of Sb and As contents in basic rocks (in ppm) according to Onishihi-Sandell (1955 — Tab. 2, p. 217).

A considerable number of data on polymetallic elements (inclusively Au, As, Sb) in rocks was presented in his monographic work by Boyle (1965, Tab. 4, p. 239). The mentioned author presents the following comparison of Sb and As contents in residual soils above the underlying green basic rocks:

	As g/t	Sb g/t	number of analyses
Soils above the basic rocks	24	2.2	8
Parent green rocks	6	1	27
Residual soils above dark shales	18	3.0	60
Parent dark rocks with organic matter	12	2.4	15
Soils above granodiorites and granites	462	10.5	4
Granodiorites, granites	12.5	<1	2

Bauge-Rössler et al. (1978) followed on the basis of analyses carried out by means of neutron activation how does the metamorphosis affect the contents of some elements, among which also the Au, As, Sb. Ta, U, Th contents in clayey-siliceous metamorphous derivates. They found out that maximum content under the lowest metamorphosed conditions is attained by Au, Cc, Hf; the maximum in the higher metamorphosed derivates (phyllites, gneisses to granulites) is attained by the W an Mo elements and Rb, Ba, Sc, Th, TRV. grouped to them Ni, Co attain maximum contents under low metamorphosed conditions (clays, claystones), but also under highly metamorphosed conditions (phyllites, mica schists). Ta, F and N maintain a stable concentration in the whole metamorphosed profile.

To the evaluation of antimon and arsenic contents in the metabasites of the tatroveporides we can say the following: Sb contents according to histograms, but also according to geometric means (Tab. 2) correspond with the data in the literature. The arithmetic means of all the 66 analyzed samples is 1.33 and the geometric means 0.979 g/t of Sb. This difference is caused mainly by some anomalous values of the Sb content which occurred probably as a result of an additional enrichment during the metamorphosis or during other disposed processes. Increased antimon contents can be brought about only partially as a result of using the 0.2 g/t Sb value during the calculations, instead of the below limit contents 0.2 g/t Sb. Similar samples amount to ten from all the West Carpathian mountain ranges.

Arsenic in metabasites has a less uniform distribution of contents than antimont. That is why it presents a great difference between the arithmetic and geometric means. Probably the polymetamorphosis connected with the sulphidization a mainly pyritization of metabasites causes this considerable unequal and anomalous distribution of arsenic. It can also be seen from the fact that the arithmetic means from the analyses of all samples is 15.4 g/t and the geometric one is 5.7 g/t. For the basalts the clark of arsenic should be about 2 g/t. Samples above the half of anomalous enrichment in arsenic. It comes from the area of the Malé Karpaty Mts. where metallogeneously appears the hydrothermal antimon mineralization enriched in arsenic. The Malé Karpaty Mts. have therefore in metabasites the highest average content of As, (A. P. = 28 and G. P. = 9), but also the content of Sb, (A.P. is 1.74 and G.P. is 1.163 g/t). Near to these values are solely the Sb and As contents from the metabasites of the Spišsko-gemerské metalliferous Mts. (see Tab. 2). It is the same also in the case of uranium.

Antimon and arsenic do not always emerge in metabasites of the West Carpathians in direct mutual relationship and only part of the samples has simultaneously an increment of contents of both elements. They are frequently the only increases of one of them.

Uranium and Thorium

The uranium and thorium contents in the fundamental types of rocks in g/t can be seen in Tab. 6 and 7.

The Th^{+4} — O bond is stronger than in the U^{+4} — O, and therefore the crystallizing differentiation decreases the Th/U ratio, obviously it is mainly in the residual solutions of pegmatites. In the zonality of zircons this ratio is higher in the medium zones of crystals.

The Tu/U average ratio for the earth crust is 3.5. Uranium and thorium in the mantle and crust rocks was studied by Lutz (1975 — Tab. 36, p. 91).

Table 6

Rock	Th	U	Th/U	K(%)	10^{-4}.K/U	Literature
Oceanic tholeiite	0.18	0.10	1.8	0.1414	1.4	Tatsumoto, Hedge, Engel, 1965
Alkali-olivinic basalt	4.61	1.14	4.0	1.24	1.08	Tatsumoto, Hedge, Engel, 1965
Alkali-olivinic basalt	6.26	1.94	3.2	1.76	0.90	Green, Morgen, Heier, 1968
Tholeiite, Japan	0.43	0.24	1.8	—	—	Tatsumoto, Nicolajsen, 1969
Tholeiite, Japan	0.71	0.29	2.4	—	—	Tatsumoto, Nicolajsen, 1969
Tholeiite, Japan	0.88	0.29	3.0	—	—	Tatsumoto, Nicolajsen, 1969
Tholeiite, Japan	1.78	0.64	2.8	—	—	Tatsumoto, Nicolajsen, 1969
Continental tholeiite	0.40	0.20	2.0	0.5	2.5	Tatsumoto, Hedge, Engel, 1965
Traps	1.6	0.85	1.8	0.52	0.6	Zolotarov, Kravčenko, Sokolov, 1973
Potassium basalt	1.8	2.6	7.0	—	—	Tichonenkova, Osokin, Nečajeva, 1971
Potassium basalt	58	9.2	6.3	—	—	Osokin, Lebedev-Zinovjev, 1973
Potassium basalt	54	6.4	8.4	—	—	Osokin, Lebedev-Zinovjev, 1973
Andesite	2.2	0.69	3.2	1.33	1.9	Taylor, 1968

Average contents of thorium and uranium in bassalts. Table taken from Lutz (1975 — p. 91, tab. 36).

Tab. 6 contains the values of both elements in various basic magmatic rocks. Further details of this kind are also in Tab. 4.

From the given tables it results that uranium and thorium cannot be considered as coherent elements, because their contents are dependent from the alcalinity of rocks. The Th/U ratio in increasing the content of alkalis displaces to the side of the more basic thorium. The smallest Th/U ratio is in the ocean basalts (1.8) and the Th/U ratio in potash basalts is 6 to 8. The continental basalts what regards the Th/U ratios stand between these types of rocks. In kimberlites the Th/U ratio is 11. Kimberlites in the USSR amount to Th 21.3 g/t and U 1.9 g/t. Similarly the change of K and U ratio takes place jointly and linearly. For basalts the K/U ratio is stabilized (about $1.5 \cdot 10^4$). According to Lutz (1975) the investigations of U and Th elements gave the following conclusions:

Uranium and thorium are incoherent elements, the mantle rocks have chondritic Th/U ratio, in magmatic rocks the Th/U ratio increases dependently on the content of alkalis in the rock (a more alkaline thorium increases). The Th/U ratio of the granulite basite stratum of the crust is analogous to tholeiites and andesite series. The granite-gneiss stratum of the continental crust has higher contents of radioactive elements and a higher Th/U ratio.

Table 7

Rocks	U n.10^{-4}	Th	Th/U	SiO_2	K %	Na %
gabbros, gabbro-amphibolites	1.1	6	5.4	54.3	1.5	3.7
basaltic porphyrites	0.7	4	5.7	48.8	0.9	2.8
gabbro-diabases and diabases	1.0	5	5.0	49.2	1.6	2.9
gabbro, gabbro-diorites	0.6	3	5.0	46.5	0.7	2.4
diorites, quartz diorites	1.3	6	4.5	58.2	1.4	3.2
basalts	0.6	3	5.0	49.5	0.7	2.3
gabbro-diabases, diabases	0.8	4	5.0	—	—	—

Average contents of radioactive elements and of other elements in basaltic rocks of the magmatic formation of the Southern Ural Magnitogorsk area. Author V. F. Richter (1975 — p. 121).

Enrichment of the crust rocks in U and Th elements takes place according to Lutz (1975) by means of acid leaching of rocks, solutions and fluids which are activized in metamorphous processes. Rocks of amphibolite metamorphous facies have a Th/U ratio higher than 4 (in average 7.3), meanwhile that of the rocks of granulite facies is smaller than 4.

U and Th contents in metabasites of the tatroveporides were determined under the conditions of relatively low sensitivity in using neutron activation, that is why mainly in uranium it is found under the detection limit (less than 0.5 g/t) 25 samples. 13 samples are in the limits from 0.8 to 2 g/t and 8 samples have high contents between 2.4 to 2.8 g/t. The arithmetic means of all determinations of uranium is 1.48 and the geometric means is 0.918 g/t. These data correspond to the contents of uranium for basaltoid rocks. It is remarkable that the greatest quantities of uranium have metabasites of the Malé Karpaty Mts. and of the Spišsko-gemerské metalliferous Mts. (MK = 2.39; SGR=2.225). For the Malé Karpaty Mts. remarkable is further on also the fact that they have very low contents of thorium, because, apart from 2 samples, all values have a thorium content below the limit, i.e. less than 0.1 g/t. of Th. The arithmetic means is 0.3 g/t, the geometric means is 0.19 g/t of Th. It is to be reminded that in all metabasites of the tatroveporides (apart from I. T. S. M.) the quantity of uranium is higher than that of thorium, which is not a current phenomenon. In the major part of mountain ranges these differences are not great. The arithmetic means of uranium contents in 66 analyses are 1.487 and of thorium 1.147 g/t. The geometric means for U=0.918 and for Th=0.415 g/t. The decrease of uranium content can be explained by the fact that in periplutonic contact metamorphosis which is widespread in the area of the West Carpathians, an important increase of uranium into metabasites took place from the surrounding environment. As a whole, however, the detected values of uranium and thorium correspond to the contents published in literature. Based on the above said it is necessary to taste that metamorphous recrystallizaion of basaltoid rocks into amphibolites led to the discruption of the Th/U raio which is characteristic for the basaltoid rocks (see Tab. 7). Our thorium and uranium ratios attain the value of about 0.9, which is an anomaly in rocks of this type as compared with the data of literature. A better clarification of this anomaly has not been made and it is to be admitted again the possibility of an incorrect analytical exceeded determination of uranium in rocks. However, this can be attained only by the verification of the correctness of the analytical data.

Wolfram

Wolfram is a typical lithophilous element, a volatile component of granite magma enriched in water, boron, fluorine and chlorine and other mineralizers and emanations. Differently from molybdenum wolfram does not form sulphides. Basic rocks contain more W than granites which is attributed to the presence of sulphides. It has been proved by the fact that almost 10 to 09 % of W content can be extracted by means of HCl (Rabinovič, 1958, in Taylor, 1965). In geochemistry it is used for the interpretations of Mo/W ratio. Wolframite and scheelite are the main sources of minerals in which wolfram accumulates.

In the area of the Malé Karpaty Mts. it has been found that scheelites accumulate dependently on the basic submarine volcanism in productive ore-bearing zones which together with the occurrence of antimonite makes possible to consider in the sense of Maucher's works this type of mineralization as syngenetical sedimentary, connected with the submarine basic volcanism. The investigation works in course, however, do not confirm this opinion.

Our results of determining the wolfram contents in metabasites of the tatroveporides are exceeded as against the data in literature. It is probable that the neutron activation causes such excess of wolfram, or other methods determine it in a low measure. Nonuniform wolfram contents in rocks of the same kind may be caused also by the fact that the bearers of wolfram are the accessories which cause difficulties in homogenizing the powder samples of rock. A certain increase could be caused also by mechanical treatment of samples (use of mills with wolfram steel). Lundegardh's data correspond with the level of wolfram contents determined by us. Smith and Curtis (1972, p. 1214 The Encyclopedia of Geochemistry) give the following table of wolfram contents in rocks:

gabbros and norites, Hevesy and Hobbie (1933)	24 g/t
basic rocks central Roslagen, Sweden Lundegardh (1946)	10 g/t
siliceous and intermediary magmatic rocks Sandell (1946)	1.5 g/t
granites Schwarzwald, Germany, Hevesy and Hobbie (1933)	83 g/t
acid rocks, central Roslagen, Sweden Lundegardh (1946)	7 g/t
W_1 basalt standard, Taylor (1965)	0.3 — 0.40 g/t

The wolfram contents in metabasites of the West Carpathians give contradictory results (see Tab. 1). 13 samples have contents below the limit (less than 1.5 g/t of W), 5 are within the range of 3—7 g/t and 24 samples have contents between 8 — 30 g/t. The arithmetic means of all values gives 10.9 and the geometric one 7.09 g/t. The smallest wolfram content have amphibolites of the Malé Karpaty Mts. A.P=7.9 and G.P.=5.1. The biggest wolfram content has the MF. NT, VT group, where A.P.=13.7 and G.P.=3.4 g/t. Comparing with the diabase standard sample (W_1) which, according to Taylor, has contents 0.3—0.46 (data obtained by means of neutron activation) we see that wolfram contents in the metabasites of the West Carpathians are too high. A rational explanation of the above mentioned fact is difficult, because the analyses of samples from one mountain range present a considerable dispersion of values. Probably only control analyses could be a starting point for further considerations. However, it is necessary to note that in literature we often find data when carrying out geochemical investigations of basic rocks, which are on the level with our results, contents cited for basic rocks are, for ex., 10 g/t, but also low contents which stand below the limit of determination.

According to Beuge and Rössler et al. (1978) wolfram accumulates in higher metamorphites. This fact could acount for the increased W in metabasites as against nonmetamorphosed rocks.

Tantalum and Niobium

Tantalum is an element which is quadrivalent in nature and forms a complex ion. Tantalum emerges in association with niobium in tantalite, columbite and other minerals. It is frequently accompanied by titanium, yttrium and lanthanides. The average tantalium content in magmatic rocks sccording to Rankama and Sahama is 2.1 g/t, in ultrabasic rocks 1 g/t, in gabbros 1.1 g/t, in diorite 0.7 g/t, in granites 4.2 g/t and in basic alkaline rocks 1.2 g/t. The tantalium is most spread in the upper lithosphere. Further information concerning its content in rocks give Tab. 3 and 4. Minerals containing tantalum accumulate in the last stages of the crystallization differentiation, and therefore its highest concentration is in pegmatites. It is one of those elements which are little mobile in the metamorphosis of rocks (compatible element). This property can be confirmed also on the example of metabasites of the tatroveporides in which the Ta representation is uniform and has stable contents. It is a relatively stable element even in rock weathering. Tantalum enters the sediments as a component of cassiterite, tantalite, columbite and rutil. It passes also into clays, bauxite and other hydromica sediments.

Lutz (1975 — Tab. 44, p. 102) gives also the Nb and Ta contents in ultrabasic and basic rocks of the USSR. The average content values are given in Tab. 4. Lutz makes several interesting conclusions on the basis of investigation of Nb and Ta contents in the mantle and crust rocks.

Ultrabasics and eclogites of the mantle have a low (chondrite) Nb/Ta ratio. Garnet peridotites and pyrope eclogites contain somewhat higher Nb and Ta contents than spinel peridotites. Compared with the mantle substratum in basalts and kimberlites both, the Nb and Ta content and the Nb/Ta relationship increas, because the easy fusible niobium increases. Acid rocks have low Nb and Ta content. The major part of crust rocks (the granito-gneissic zone) has the Nb/Ta ratio about 10 and rocks from granulite facies (the granulito-basite zone) about 12.

Lutz has the opinion that in the process of selective melting the easy fusible niobium accumulates more as against the tantalum. These elements are not leached by solutions and fluids and therefore they are not evidently mobilized into the crust rocks.

Unfortunately the analyses of niobium could not be carried out by means of neutron activation and the X-ray analysis, through the means of which

Table 8

Mountain ranges	Zr	Hf	Zr/Hf	Literature
chondrite	33	1.3	43	Mason, 1965
oceanic basalt	100	2.0	50	Brett, 1971
average basalt	110	2	55	Taylor, 1968
andesite	110	2.3	48	Taylor, 1968
oceanic basalt	87	2.1	41	Brooks, 1970
tholeiite	190	3.3	57	Brooks, 1970
alkaline basalt	176	2.9	61	Brooks, 1970
nepheline basalt	235	3.5	67	Brooks, 1970
trachyte	1515	17.3	85	Brooks, 1970
two-pyroxene granulite	132	2.8	47	Brooks, 1970
gneiss-granulite facies	20-500 / 158	3.5	23-66 / 45	Curie, 1968
shale	160	2.8	57	Wedepohl, 1968
granite	180	4	47	Taylor, 1968

Zr and Hf contents in magmatic and metamorphous rocks according to Lutz (1975 — Tab. 43, p. 100).

this element could be determined was not used. That is why we have at the disposal only the tantalum contents from this couple of elements petrogenetically important. From the histograms (Fig. 1b) we can see the small dispersion of this element (between 0.02 to 0.1 g/t), meanwhile 21 samples have contents below the limit less than 0.02 g/t. Most of contents below the limit have metabasites of the Malé Karpaty Mts. (8 from 10 cases). The tantalum arithmetic means in metabasites of the Malé Karpaty Mts. amounts to 0 028 g/t, which is the lowest value in comparison with the samples from other mountain ranges. The whole content arithmetic means in all analyzed samples is 0.044 and the geometric one is 0.033. This small difference between the two averages indicates the content homogeneity of tantalum in metabasites of the West Carpathians. Comparing tantalum contents with the data in literature, we find 10-fold and more multifold decrease of contents in samples analyzed by us. It is hard to explain this contradiction. Similar low contents of tantalum should have only chondrites (0.04 g/t) see Tab. 3. According to the mentioned Tab. the basalts should have 0 5 g/t and our Ta average contents is 0.04 g/t. It appears that this difference should be rather attributed to the analytical method than to the specificity of metabasites of the Western Carpathians. The decrease cannot be explained even by the Ta migration in the metamorphous conditions, as it is a compatible element.

Geochemistry of Hafnium (Hf)

The Hf content in the earth's crust is estimated to 3 to 4.5 g/t. To the Zr/Hf ratio is devoted the special work of Brooks (1970) in which the author states that the Zr/Hr ratio in most magmatic rocks of the crust, resp. in rock-forming minerals, ranges about the value of 37. The Hawaiian lavas have this ratio increased, because they include also highly differentiated rocks (alkaline). Most of these data are given in Tab. 8.

A rough recapitulation of the Zr/Hf ratio in rock groups studied by B r o o k s (1970) is following: the Zr /Hf ratio of the Skaergaards magma is a bout 36, similarly that of the alkaline intrusions of the Eastern Greenland. The average of basic rocks of Scotland from Garabal Hill—Glen—Fyne is 37 and granites from the Skye island (Scotland) give an average of 38. The average of the Zr/Hf averages of the Hawaiian lavas is about 57 and the total average of

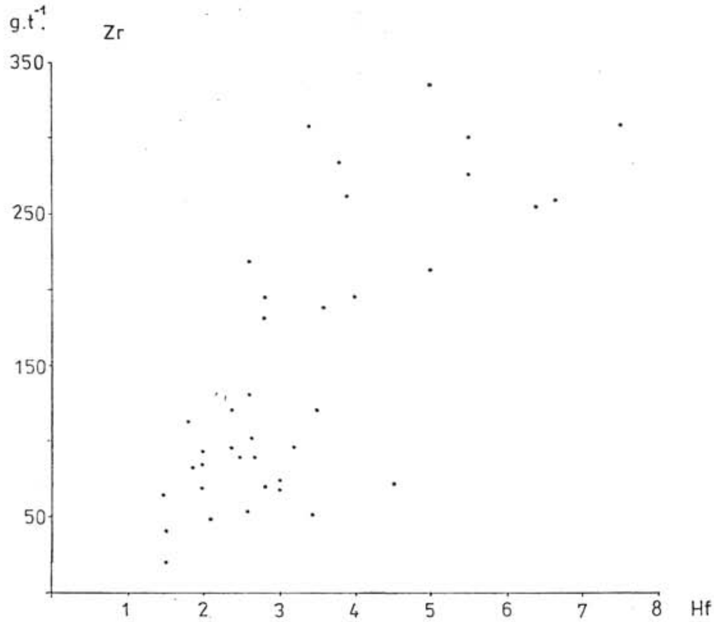

Fig. 2. Zr-Hf correlation graph-according to contents of these elements in metabasites of the tatroveporides.

values of all the values of 47 samples of rocks and minerals is 44. E h m a n n et al. (1978) states that the Zr/Hf ratio fluctuates from 38 to 42. The tholeiitic magma does not change this ration in differentiation, similarly the regional metamorphosis either. The olivine basalts from the St. Helena island have a Zr/Hf ratio of 47. This ratio changes in differentiation into phonolite to 60. The Moon samples indicate a change in reduction conditions of their formation, the Zr/Hf ratio for anorthosites is 21 and for basalts 46, the zircon content of chondrites is 4 g/t with the Zr/Hf ratio between 34 — 66. L u t z (1975) dealt also with the Zr/Hf ratio, as well as with the content of elements in basic and ultrabasic rocks. A table of contents of these elements in the fundamental mantle and crust rocks is taken from his work (Tab. 6). Lutz points to the fact that rocks with a high content of Zr do not manifest an adequate increase of Hf content. This law was detected by C u r i e (1968 in Lutz 1975) in metabasites of the granulite facies, from the Ontario area. Increasing of the Ti/Zr and Zr/Hf ratio value in alkaline basalts, kimberlites

Table 9

Average contents Zr and Hf and the ratio Zr/Hf according to individual mountain-ranges and their chains of West Carpathians

Mountain ranges	Zr	Hf	Zr/Hf
MK	117,4	2.62	43.64
I,T,S,M	250	4.52	55.30
MF, NT, VT	165.1	3.64	45.35
VEP	103.5	2.83	36.57
SGR	152	4.7	32.34
TATRIDES	168.28	3.4	49.37
TATRIDES + VEP	147.3	3.2	45.73
TATRIDES + VEP + SGR	150.9	3.4	44.83

Zr and Hf primary contents and the Zr/Hf ratio according to individual mountain ranges of the tatroveporides of the West Carpathians.

and metamorphites, according to Lutz, bear proof to the fact that Ti, Hf and Zr cannot be included into the group of coherent elements.

The fundamental conditions of U, Th, Ti, Zr, Hf, Nb, Ta elements are taken from Lutz' table (1975, Tab 58, p. 136) and inform additionally about the changes of contents of given elements in fundamental magmatic rocks of basalt character (see Tab. 4 in this part).

According to Tab. 1 and 2. and according to histograms (Fig. 1 a, b) it can be stated that hafnium contents in metabasites of the tatroveporides range between 1—4 g/t. The arithmetic means of all samples is 3.37 and the geometric is 3.05. These data correspond to those of literature, for ex. in Tab. 4 the hafnium content in alkaline olivine tholeiites is 3.5 g/t. The hafnium contents are approximately similar in samples from all the mountain ranges, even when the metabasites of the Malé Karpaty Mts. and of the Spišsko-gemerské metalliferous Mts. have the lowest arithmetic and geometric means of the hafnium contents. (MK = 2.62; SGR = 1.78 g/t). From Tab. 1 and 2, Fig. 2 we can see the positive correlation between Zr and Hf. Due to this relationship we gave also the contents of zircon in tables. From this results also why metabasites of the Spišsko-gemerské metalliferous Mts. and of the Malé Karpaty Mts., having small contents of Zr, have the smallest Hf contents. Tab. 8 give the Zr, Hf content and the Zr/Hf ratio in individual groups and average contents.

Scandium

The authors gave in Tab. 1a the values of scandium obtained by neutron activation (the number in the numerator, resp. Sc—1) and the values obtained by spectral analysis (the number in the denominator, resp. Sc—2). The comparison of results has shown that in determining scandium by neutron activation, according to 66 analyses, gives higher contents than the spectrochemical analysis:

neutron activation:	A.P. = 46.44	G.P. = 45.63
spectrochemical analysis:	A.P. = 35.63	G.P. = 33.13

Conclusion

The investigations have clarified that metabasites from various mountain ranges of the West Carpathian area have very similar contents of metallic elements studied by us. The areas of the Malé Karpaty Mts. and of the Spiš-sko-gemerské metalliferous Mts are the most similar what regards the representation of contents of these elements. They have increased contents of Au, Sb, As, U and Th. The areas of Inovec and Tribeč mountain ranges, what regards the contents stand in the transition to the remaining two mountain ranges (VEP, MF, VT, NT). A simultaneous increase and a content relationship of association of elements Au, Sb, As, U and Th can be observed in several samples, which may be a proof of metallogeneous activity and migration of the mentioned elements in the rock environment in metamorphous and other loaded (hydrothermal) processes.

In general we can say that the basic rocks of the West Carpathians are the bearers of numerous metals and that they can form conditions suitable for their accumulation, or be the source in material mobilization of utility elements. Loaded metamorphous and metallogeneous processes (mainly hydrothermal) can then mobilize ore components from the said metamorphites into deposit accumulations. The metamorphosis of basic rocks, against primary rocks, causes migration and local nonuniformity of distribution of some elements in basic metamorphites studied by us, causes their decrease (Uranium), or their nonuniform increase of Au, Sb. As. The tantalum remains uniformly dispersed and maintains on the level of primary distribution, differently from the wolfram which has a variable content representation, primarily low, or strongly exceeded.

However, we have the opinion that U, W. Ta elements in this work have not a quite reliable analytical determination. That of tantalum decreased, and of wolfram and uranium increased, a witness to it may be the low Th/U ratio. However, it must be admitted that there is the possibility of anomalous uranium increase against the thorium in polymetamorphous processes to which the metabasites were submitted.

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