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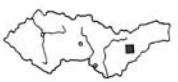
AGE OF GRANITOIDS FROM THE KOHÚT VEPORIC ZONE ACCORDING TO Rb—Sr ISOCHRONE ANALYSIS

(Figs. 9, Tabs. 4)



A b s t r a c t: Rb—Sr isochrone analyses of granitoid rocks from the southern part of the Veporic zone — the so-called Kohút zone are presented in the paper. In this region, Sinec (Rimavica) type of granitoids, formerly considered to be Late Palaeozoic till Neoide occurs. Present isochrone research determines them as equivalents of granitoids of the Sihla type (387 ± 27 m.y.). Sinec (Rimavica) granite reaches an age of 392 ± 5 m.y. This raised age must be partly ascribed to additional processes which took place in the stage of retrograde alterations (B i b i k o v a et al., in the present issue). The above-mentioned conclusions are of considerable importance in clarification of metamorphic age and stratigraphy of the crystalline complex in the region of the southern Veporic zone.

Р е з ю м е: В статье приводятся Rb-Sr изохронные анализы гранитоидных пород южной части вепорика — т. н. когутской зоны, где встречается синецкий (римавицкий) тип гранитоидов, раньше считаемый позднепалеозойским — неоидным. Современные изохронные исследования определяют их как эквиваленты гранитоидов типа Сигла (387 ± 27 млн. лет). Синецкий (римавицкий) гранит имеет возраст 392 ± 5 млн. лет. Этот повышенный возраст необходимо отчасти приписать дополнительным процессам, которые произошли на стадии ретроградных изменений (B i b i k o v a et al., в настоящем номере). Приведенные заключения имеют существенное значение для объяснения возраста метаморфизма и стратиграфии кристаллиникума в районе южного вепорика.

Results of geochronological research of the Western Carpathian granitoid and metamorphic rocks obtained by Rb—Sr isochrone dating method have been systematically published in cooperation with Laboratory of Nuclear Geochronology and Isotopic Research at Institute of Geological Sciences, Armenian Academy of Sciences in Erevan led by Dr. G. P. B a g d a s a r y a n. These works published mainly in Geologický Zborník — Geologica Carpathica are quoted in references. Survey of geological data obtained by Rb—Sr isochrone method is given in Tab. 1.

Though quite a lot of analyses have been carried out at Erevan Institute in cooperation with Dr. G. P. B a g d a s a r y a n and Dr. R. Kh. G u k a s y a n, a part of core mountains remains undated. Therefore, we have no information on age of granitoid rocks from the whole region of the Western Carpathians

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Table 1

Granitoids of the Western Carpathians dated by Rb-Sr isochrone method

	$(^{87}Sr\ ^{86}Sr)_0$	age (m. y.)
Malé Karpaty Mts., Bratislava massif Bagdasaryan et al., 1982	0.7076	347 ± 4
Malé Karpaty Mts., Modra massif Bagdasaryan et al., 1982	0.7078	326 ± 22
Malé Karpaty Mts., regional periplutonic metamorphism of shales from the Pezinok--Pernek zone, Bagdasaryan et al., 1983	0.7100	387 ± 38
Low Tatra Mts., Ďumbier and Prašivá massifs, Bagdasaryan et al., 1985	0.7079	362 ± 21
Low Tatra Mts., granites of Králička type, Bagdasaryan et al., 1985	0.7157	365 ± 17
High Tatra Mts., granitoids, Malý Koscielec, Burchart, 1968	0.706	300 ± 15
Suchý — Malá Magura Mts. Kráľ et al., 1987	0.7060	393 ± 6
Veporic zone, Vepor and Ipeľ types Bagdasaryan et al., 1986	0.7060	284 ± 22
Veporic zone, Sihla type Bagdasaryan et al., 1986	0.7054	387 ± 27
Kohút Veporic zone, Sinec (Rimavica) type, ZK samples	0.7080	382 ± 13
Kohút Veporic zone Krokava region, Sinec (Rimavica) type	0.7077	394 ± 6
common isochrone from the values of Tabs. 2 and 3, Sinec (Rimavica) type	0.70778	392.5 ± 4.5 392 ± 5
Kohút Veporic zone, Sinec (Rimavica) type, region of Chyžné village	0.7072	384 ± 48

(Tribeč, Veľká and Malá Fatra, Žiar, Branisko, Čierna Hora Mts. and north-eastern part of the Veporic zone building up the Low Tatra Mts.).

Problems of geological structure, tectonics and age of rocks from the Veporic crystalline complex (Figs. 1, 2) are complicated throughout the Veporic zone (Bezák—Planderová, 1981; Bezák, 1982; Hovorka, 1986; L. Kamenický—J. Kamenický, 1983; J. Kamenický, 1977 a, 1977 b; Klinec,

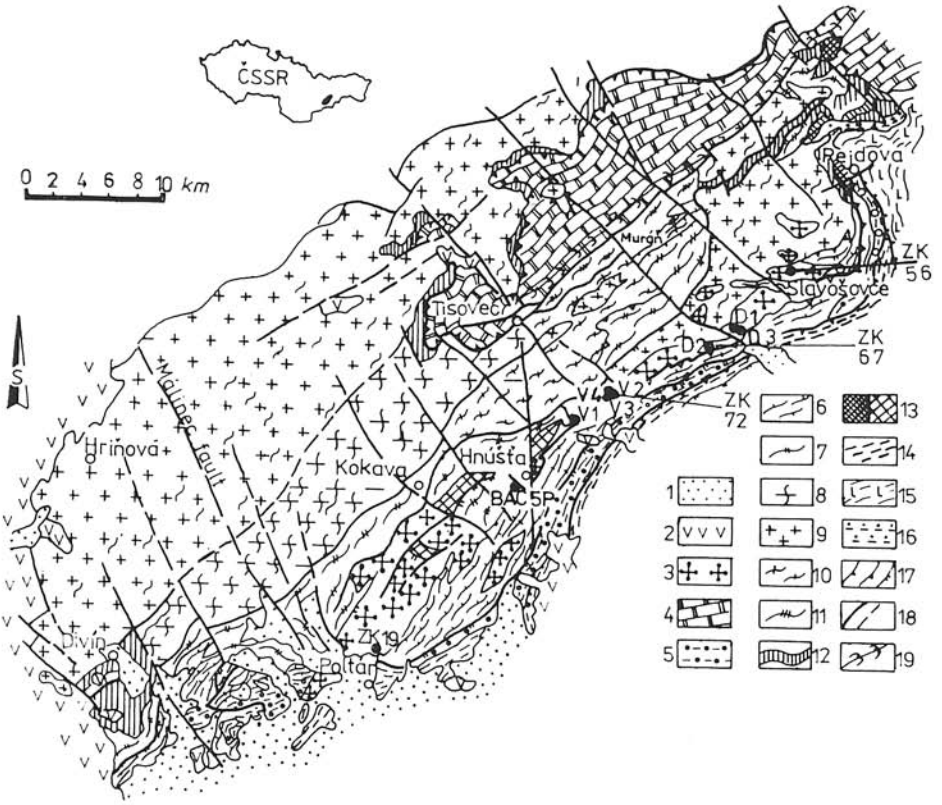

Fig. 1. Tectonic outline of the Kohút and a part of Kráľova hoľa Veporic zones (in M a h e ľ, 1986) with denotation of the studied samples localization (a part of published map reduced by Ľubietová and Kraklová zones).

Legend: 1 — filling of Neogene basins; 2 — neovolcanic rocks; 3 — Late Paleozoic (?) (Rimavica) and Mesozoic (Rochovce) granite*; 4 — Muráň Nappe; 5 — Permian slices from the Rimava sequence; 6 — Hladomorná dolina valley sequence including the Carboniferous Slatvina sequences (3, 5, 6 — Rimavica unit); 7—9 — Kráľova hoľa Nappe: 7 — paragneisses, 8 — hybrid granitoids, Vepor type, 9 — granitoids of the Sihla type; 10 — mica schists of the Brezina type; 11 — Muráň orthogneisses; 12 — envelope Struženík sequence; 13 — Predná hoľa sequence (Markuška Nappe ?); 14—15 — Gemeric zone: 14 — Carboniferous — Ochtiná sequence; 15 — Rakovec sequence; 16 — Carboniferous — Hámor sequence; 17 — displacement lines: a) of the 1st order, b) of the 2nd order, c) smaller overthrusts and upthrusts; 18 — faults; 19 — axes of synclinoria; S-north.

* The present paper changes old presupposed stratigraphic classification according to new radiometric dating. See the results of Rb-Sr analyses of granitoids of the Sinec (Rimavica) type from the Kohút zone.

1962, 1966, 1973, 1980, 1984; Klinec et al., 1975, 1979, 1981; Maheľ, 1986; Maška—Zoubek, 1960; Vozárová—Vozár, 1982).

It is a region with quite variable types of granitoid rocks with various degrees of transient forms of granitoids from petrographically and structurally homogeneous to evidently hybrid types or to the rocks with various degrees of granitoid magma differentiation. In numerous cases affection of granitoid rock by metasomatic processes and K-rich fluids of different nature taking place in various stages of the Variscan plutonism development is evident (J. Kamenický, 1961). Granitoid rocks from the Veporic zone were formed under different genetic conditions, they cooled in various deep horizons of the crust and in various stages of development and time of granite plutonism.

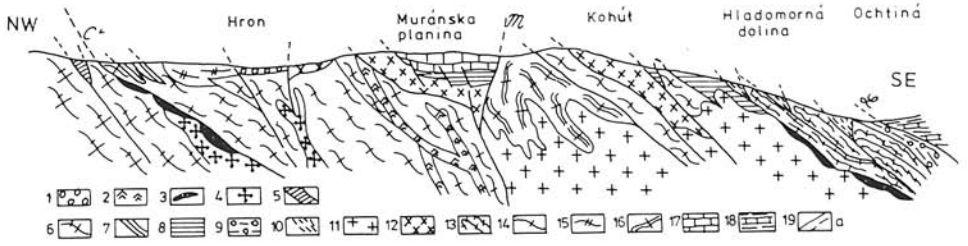

Fig. 2. Schematic profile of the Veporic zone between Čertovica and Ochtiná (Klinec, 1985, in Maheľ, 1986).

Legend: 1 — Tertiary sediments; 2 — neovolcanic rocks; 3 — basic and ultrabasic rocks; 4 — Alpine granites and pegmatites; 5—6 — Tatric zone: 5 — Mesozoic members; 6 — magmatites and paragneisses; 7—16 — Veporic zone: 7 — Bacúch Mesozoic — root Mesozoic members of the Krížna Nappe; 8 — Permian — Lias — Struženík unit; 9 — South Veporic Permian — sporadically Lower Triassic quartzites, 10 — Carboniferous — Slatvina sequence; 11 — Late Palaezoic and Palaeoalpine granites; 12 — granitoids and migmatites from the Kráľova hoľa Nappe, 13 — Late Palaeozoic — Hladomorná dolina valley Formation; 14 — Early Palaeozoic — Hron sequence; 15 — Beňuš paragneisses; 16 — Muráň gneissose granites; 17—18 — Gemeric zone: 17 — Muráň Nappe (including slices of the Vernár unit); 18 — Ochtiná Carboniferous; 19 — displacement lines: a) faults, M — Muráň line, Č — Čertovica line, L — Ľubeník line.

Time span of the granite plutonism was probably longer by something more than 100 m.y., if taking hitherto obtained geochronological results not yet verified by various methods into consideration. Thus a long process of magmatic activity manifestations comprises a period of Caledonian and Variscan era boundary (Devonian to Permian).

If we come out from the existing geochronological Rb—Sr isochrone data of granitoids except those from the Veporic zone, in can be stated that granite plutonism took place also in the period from the Permian to the Cretaceous—Jurassic (Kovach et al., 1979, 1986). Similar great differences in model ages of individual minerals from these rocks were established by K-Ar analysis carried out by Kantor—Rybár (1979).

Rb—Sr data from the Western Carpathians suggest that Variscan plutonism in the Veporic zone (Tab. 1) culminated in various regions in the period ranging approx. from 340 to 390 m. y., i.e. from the beginning Middle Devonian to the

ending Lower Carboniferous. This changes the present view that the main stage of granite plutonism processes took place in the Lower Carboniferous, viz. in the late orogenic stage of the Variscan orogeny. Results of some analytical data which must be further verified (Kovach et al., 1986) indicate that the Variscan plutonism continued even in the Middle and Upper Carboniferous and it reached even the Permian (or the younger periods).

Veporic granitoids have the features of anatectic structures in numerous places, but there are also the rocks which have a character of rocks formed by intrusion of homogeneous, relatively leucocratic magma. They are usually younger and they form smaller bodies and veins in granite massifs. Besides this, there are types affected by retrograde metamorphism in the Variscan orogenic--magmatic cycle. Dynamometamorphic alteration of rocks of various intensity was manifested in the Alpine orogeny. This metamorphism has sometimes regional character, sometimes it is concentrated only to mylonite zones. Low-temperature mechanical destruction of rocks is concerned, not recrystallization under higher thermodynamic conditions (to amphibolite facies) as presupposed by V r á n a (1964, 1966, 1980), J. K a m e n i c k ý (1967, 1977, 1981, 1982) and others. Such high-temperature products of superposed alteration of granitoids are the results of retrograde metamorphism of granitoids from the period of regressive stage of the Variscan magmatism (C a m b e l—K o r i k o v s k y, 1986; C a m b e l et al., 1986), and they cannot be considered as progressive high-grade metamorphism in the Alpine orogeny.

Typical feature of the Veporic granitoids is their occurrence (especially in the southern Veporic regions) in large zones of crystalline schists (biotite phyllites, gneisses, migmatites, sporadically with transitions to hybrid granitoids).

In the present stage of the Veporic Variscan plutonism products dating we have only Rb-Sr isochrone ages of basic types of the Veporic granitoids forming the main Veporic structural units at our disposal. Younger, less widespread veiny or projection forms mostly of differentiated leucocratic granitoids are not yet analyzed geochronologically. These are bodies occurring in the basic types of granitoids (in Sihla, Vepor or Ipeľ types or in the granitoid rocks from the Kohút zone including the Sinec — Rimavica type). The present erosive surface of the Veporic zone uncovers, on one hand, relatively deep parts of the crust (subautochthonous to autochthonous horizons of anatexis in which granitoids were formed, and, on the other hand, the higher horizons of shaly crystalline complex with dominating intrusive complexes of granitoid rocks can be found in the Veporic zone. Regional periplutonic or typical contact metamorphism manifested in shales by formation of hornfelses containing andalusite and cordierite is connected with these complexes.

Research of the Veporic granitoid complexes formed during various stages of the Variscan (or Caledonian—Variscan) plutonism is complicated by complexity in clarification of mutual relations between individual granite types. Genetically and petrographically transient types formed under complicated and often combined conditions of mutual affection of geological, lithological and thermodynamic factors are frequent too.

Insufficient exposure of the field, namely impossibility to always observe individual complexes in continuous exposures, but only according to local outcrops of rocks to the surface not connected with each other, impedes to make unequivocal genetic-petrological interpretation of individual granitoid

types. Tectonic processes — Variscan and Alpine — often joined together different types as far as genesis and depth are concerned, or, on the other hand, they divided petrologically uniform complexes, or they affected them tectonometamorphically to a various extent. It is valid so much the more that the Variscan retrograde metamorphism and the Alpine mylonitization (tectonometamorphism) are often regionally distributed or they are combined with each other (Cambel — Korikovsky, 1986; Cambel et al., 1986). For these reasons, several essential problems of the Veporic granitoids research cannot be solved only by surficial research, but by geochemical-mineralogical-petrological and dating radiometric research as well.

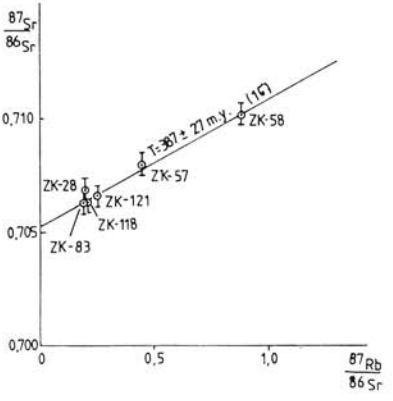

Fig. 3. Rb-Sr isochrone graph of granitoids of the Sihla type from the Vepor pluton (Bagdasaryan et al., 1986).

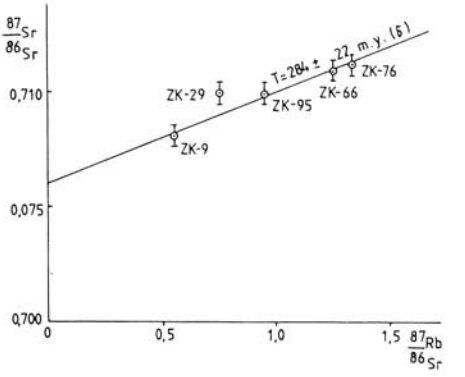

Fig. 4. Rb-Sr isochrone graph of granitoids of the Vepor and Ipeľ types from the Vepor pluton (Bagdasaryan et. al., 1986).

Main task of the present stage of geochronological research was to clear up an important question of age of granitoids of those basic types which are significantly taking part in the structure of the Veporic zone. The most spread, but also the most monotonous type is the Sihla type (see Fig. 3). It is represented by medium-grained biotite granodiorites to biotite tonalites.

Granitoids of the so-called Vepor type (Fig. 4) are more extensively distributed. Type with marked porphyric K-feldspar phenocrysts often of pinkish to red colour called by Krist (1977) Ipeľ type belongs to this group. Problem of age of the Sihla and Vepor-Ipeľ types was solved by Bagdasaryan et al. (1986) (Figs. 3, 4). From these results it follows that the Vepor and Ipeľ rock types are considerably younger in comparison with granitoids of the Sihla tonalite and, therefore, they belong probably to a separate intrusive stage. Another interpretation is represented by secondary (late or postmagmatic) affection of granodiorites and tonalites of the Sihla type by high-temperature fluids causing K-metasomatism which produces porphyric rocks of granite composition. This process would be able of total homogenization of Sr isotopes and resetting of rocks of original Lower Devonian age, because Vepor-Ipeľ

granitoids gave their own isochrone: 284 ± 22 m. y. Therefore, metasomatic genesis of the Vepor-Ipeľ type of granitoids is less probable, though local K-metasomatism manifestations were observed.

In the present work results of dating of granitoids from the southern part of the Veporic zone, the so-called Kohút zone, by Rb-Sr isochrone method are given. It is pertain mainly to granitoids of the Sinec (Rimavica) type. These granitoids were so far presupposed to be of Late Variscan or Mesozoic age, especially on the basis of K-Ar dating and presumed occurrence of some veiny apophyses in the Late Palaeozoic of the Veporic zone. Silurian — Middle Devonian age of hornfelsic metamorphism in the shaly complex of the Hladomorná dolina valley was proved (K l i n e c — P l a n d e r o v á, 1981). Late Palaeozoic or Neoide age of veiny leucocratic types is assumed also by B. C a m b e l (in B a g d a s a r y a n et al., 1986), J. K a m e n i c k ý (1977) and others.

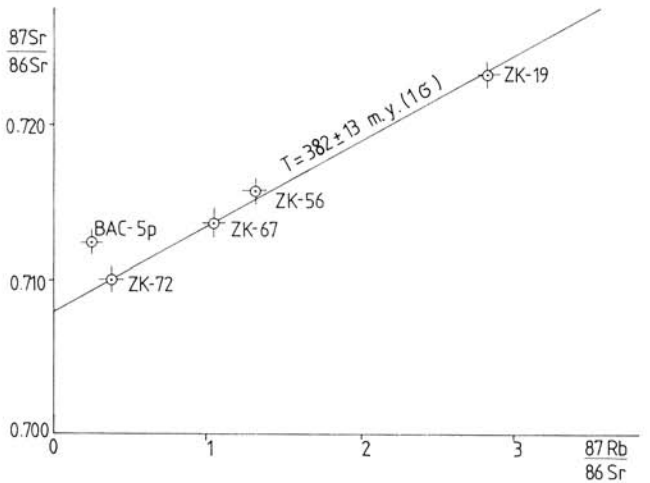

Fig. 5. Rb-Sr isochrone graph of granitoid of the Sinec (Rimavica) type from the Kohút Veporic zone.

Granitoids of the Kohút zone in the southern part of the Veporic zone, but especially the Sinec (Rimavica) granite are spreading on the boundary of phyllites of the Hladomorná dolina valley. Granitoids penetrate also mica schists of the Brezina type determined as the Silurian to Lower Devonian by K l i n e c — P l a n d e r o v á (1979). Granitoids of the Kohút zone have a variable composition ranging from granite, leucogranodiorite, leucotonalite to tonalite. But substantial part of the rocks is granitic, two-micaceous and relatively leucocratic.

Problem of age obtained by zircon analysis using U-Pb method was already dealt by C a m b e l et al. (1971). Model age of zircon separated from the Sihla tonalite from the road Čierny Balog — Sihla (locality Tlstý Javor) is given in the above work. Age of zircons was determined to 380 m. y. and

age of granitoids of the Ipeľ type was derived from zircons whose age equals to 320 m. y. In the latter case, these are leucocratic granodiorites of anatectic origin from the quarry at Dobroč village which are found in the zone where porphyric granitoids of the Ipeľ type occur.

As the authors presupposed a possibility of diverse results of isochrone research according to various regions and different rock types, 3 groups of samples belonging to the rocks of the Sinec (Rimavica) body were taken from the Kohút zone for Rb-Sr isochrone research. Numeric data are given in Tabs. 2, 3, 4 and their graphic representation in Figs. 5, 6, 7, common graph is in Fig. 8. For comparison, graph from the work of K r á ľ et al. (1987) — Fig. 9

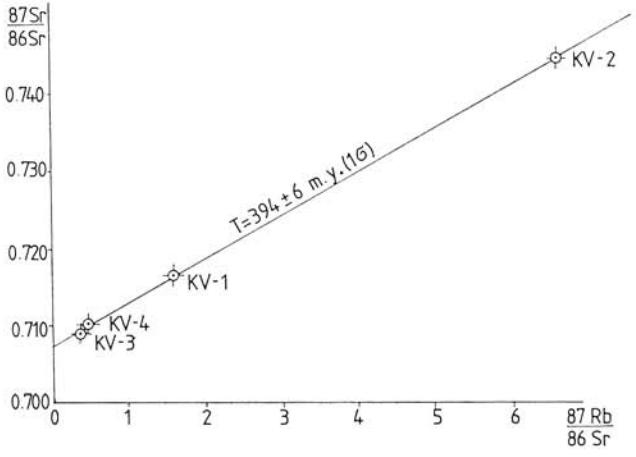

Fig. 6. Rb-Sr isochrone graph of granitoids of the Sinec (Rimavica) type from the Kohút Veporic zone (Krokava region).

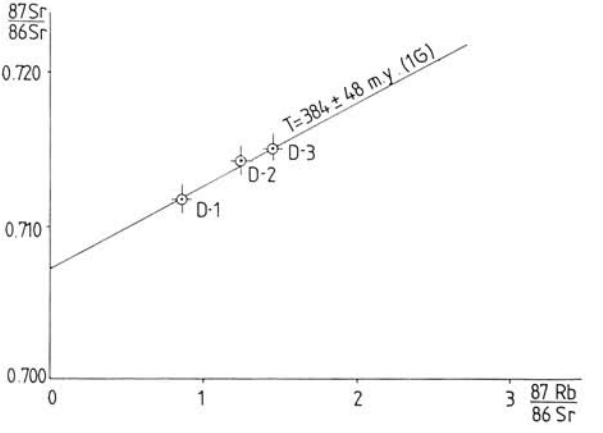

Fig. 7. Rb-Sr isochrone graph of granitoids of the Sinec (Rimavica) type from the Kohút Veporic zone (region of Chyžné village).

Table 2

Isotopic-analytical data on granitoids from the Kohút Veporic zone — Sinec (Rimavica) type

Sample number	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$ at. ratios	$^{87}Sr/^{86}Sr$ at. ratios
BAC-5p	21.36 21.22	233.85	0.263	0.7127 0.7121
ZK-72	69.38 70.73	515.66	0.893	0.7099 0.7101
ZK-67	114.83	317.56 310.16	1.058	0.7137
ZK-56	122.03 120.09	261.75 260.20	1.342	0.7156 0.7158
ZK-19	149.68 148.09	154.90 148.19	2.842	0.7233

Equation of regression line (without the sample BAC-5p) represents an isochrone $Y = (0.7080 \pm 0.0003) + (0.005420 \pm 0.000178)\ X$, $T = 382 \pm 13$ m. y. Errors are on 1 σ level. $\lambda\ (^{87}Rb) = 1.42 \times 10^{-11}$/yr.

BAC-5p cutting of forest road on the eastern slope of Mt. Sinec, ca. 500 m west of settlement in Hnúšťa, 55° 800 m from elev. point 759 (Burianka);
ZK-72 muscovite-biotite granodiorite, road to Krokava, 219° 2.8 km from Ratkovské Bystré village, N of Jelšava village, Kohút Veporic zone;
ZK-67 muscovite-biotite granodiorite, Lubeník, quarry near dam, Kohút Veporic zone, 119° 3.2 km from Revúca village;
ZK-56 biotite granodiorite, Čierna Lehota village, quarry on the SW border, Kohút Veporic zone;
ZK-19 muscovite-biotite granite, road Poltár — České Brezovo, first quarry on the E side, Kohút Veporic zone, 180° 2.6 km from České Brezovo village.

representing Rb-Sr isochrone dating of granitoids from the Strážovské vrchy Mts. (Suchý, Malá Magura Mts.) is presented. Identical age as that obtained for the granitoids of the Sihla type and the Kohút zone (Sinec — Rimavica type) follows from this plot. Initial ratio of Sr isotopes $^{87}Sr/^{86}Sr$ equals to 0.7060 in the Suchý Mts., it is the lowest value from the hitherto made measurements (excluding tonalites of the Sihla type).

From the isochrones represented in Figs. 5, 6, one isochrone (Fig. 8) giving an age of 392.5 ± 4.5 m. y. and initial ratio of Sr isotopes $^{87}Sr/^{86}Sr = 0.70778$ was constructed.

Tabs. 2, 3, 4 and Figs. 5, 6, 7, 8 bring new data and Figs. 3, 4, 9 recapitulate important conclusions enabling to make a comparison. Tab. 1 contains the hitherto obtained isochrone ages determined by Rb-Sr method from the various mountain ranges of the Western Carpathians and initial ratios of isotopes $(^{87}Sr/^{86}Sr)_0$.

Table 3

Isotopic-analytical data on granites from the Kohút Veporic zone — Sinec (Rimavica) type (Krokava region)

Sample number	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$ at. ratios	$^{87}Sr/^{86}Sr$ at. ratios
KV-1	99.58	180.54	1.596	0.7166 0.7169
KV-2	119.07 121.79	53.32 52.50	6.584	0.7447 0.7443
KV-3	65.61 63.70	518.40	0.361	0.7089 0.7096
KV-4	70.83 72.81	478.14 466.16	0.440	0.7109 0.7101

Equation of regression line represents an isochrone $Y = (0.7077 \pm 0.0003) + (0.005598 + \pm 0.000089)$ X. T = 394 ± 6 m. y. Errors are determined for 1 σ level.

KV-1 wall exposure 1200 m SE of Mútnik deposit (Hnúšťa), ca. 350 m SSE (135°/370 m) from elev. point 411.0;
KV-2 (130°/500 m) from Krokava village, in cutting of road to Burda, Kohút Veporic zone, ca. 300 m S of pioneers' camp in Krokava;
KV-3, KV-4 the same localization as in KV-2.

The given samples represent 3 varieties of the Sinec granodiorite occurring in exposures of ca. 30 × 4 m in road cutting, as well as on the slope near Krokava brook. These are rocks of various stages of differentiation.

Tab. 2 — Fig. 5 present 5 samples from the group denoted by symbol ZK (Cambel et al., 1982) falling reliably on the isochrone except the sample BAC-5p which lies outside the isochrone. Isochrone age of this group of samples is 382 ± 13 m. y. Initial ratio of isotopes $^{87}Sr/^{86}Sr = 0.7080 \pm 0.0003$. It should be noted that the sample BAC-5p lies outside the isochrone for the following reasons: Sample occurs in the Sinec type of the Sinec massif and it belongs to those veiny leucocratic projections of granitoids which are younger (closer relation of this rock to the basic type cannot be, unfortunately, solved by surficial observation). In contrast to other samples of the Sinec type, the said sample does not contain K-feldspars, plagioclases (albite — oligoclases) are relatively fresh (they are quite less sericitized than in the other samples), biotite is totally missing, chess-board albite is quite frequent, but transitions from orthoclase — pertite to orthoclase suggesting alteration of K-feldspars by sodium metasomatism are absent. Dactylitic symplectites of muscovite and quartz are probably of hydrothermal-metasomatic origin. Consequently, it is a leucocratic veiny variety of relatively younger rock than the main body of the Sinec granitoids. This variety underwent hydrothermal-autometasomatic alteration.

Autometasomatic processes can be considered processes going back to the period of the Variscan changes and the mentioned variety need not be considered an Alpine granite, but a relatively younger rock in relation to the basic Sinec (Rimavica) type.

Tab. 3 — Fig. 6 represent the samples taken from distinctly differentiated rocks of medium-grained two-micaceous granitoids type occurring at the road leading to sanatorium at Krokava village (taken by J. D u p e j and S. P. K o r i k o v s k y). From the samples given in Tab. 3 an isochrone (Fig. 6) whose inclination corresponds to the age of 394 ± 6 m. y. was constructed. Initial ratio of Sr isotopes is 0.7077 ± 0.0003. This locality comprises also the sample ZK-72 from Fig. 5.

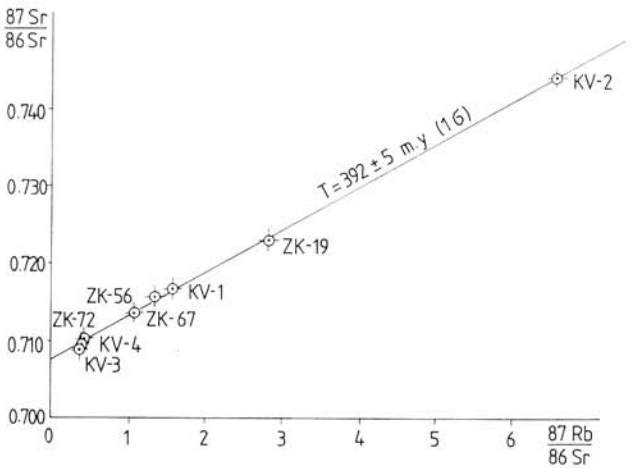

Fig. 8. Common Rb-Sr isochrone graph of granitoids from the Kohút Veporic zone.

As the results of statistic analysis have shown, differences in the ages and initial ratios of these two rock types are quite accidental for level of significance of 0.05, so all analyses of the samples from the both isochrones may be joined together and an uniform isochrone (Fig. 8) may be constructed. Calculations for all 8 samples give the following regression equation: Y = (0.70778 ± ± 0.00017) + (0.005574 ± 0.000063) X.

Regression line represents isochrone corresponding to the age of 392.5 ± 4.5 m. y. (392 ± 5 m. y.) (Fig. 8). Initial ratio is 0.70778 ± 0.00017, errors are determined for 1 σ level.

In Tab. 4 isotopic-analytical data of the granitoids of the Sinec type from the region of Chyžné village taken by B. C a m b e l and J. D u p e j are presented. Isochrone age of these rocks represents 384 ± 48 m. y. (Fig. 7), initial ratio of Sr isotopes equals to 0.7072 ± 0.0008. High error is caused here by the fact that the isochrone has its projection points not spread, because the samples have close Rb/Sr ratios and a number of analyzed samples is insufficient. Model age of zircon from granite at Chyžné village established by U-Pb method is 320 m. y. (C a m b e l et al., 1971).

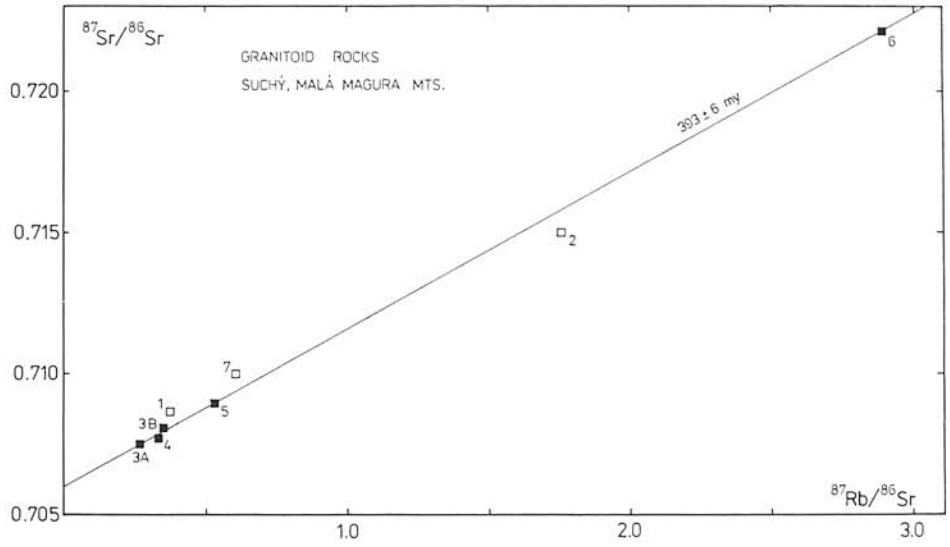

Fig. 9. Rb-Sr isochrone graph of granitoids from the Suchý and Malá Magura crystalline complexes (K r á ľ et al., 1987).

Thus, all 3 groups of analyzed rocks from the Kohút Veporic zone have approximately the same age — about 380 m. y. and similar initial ratios of Sr isotopes 0.7072 to 0.7080 referring to presence of crust material in their formation. Relative errors of determination of ratios $^{87}Rb/^{86}Sr$ = 2 — 2.5 %, $^{87}Sr/^{86}Sr$ = 0.1 %. Decay constant of ^{87}Rb = 1.42×10^{-11} years^{-1}. Herein it should be mentioned that model ages in zircons determined by U-Pb method by N. P. S h c h e r b a k (Kiev) and lately by E. V. B i b i k o v a (Moscow) gave 350 m. y. in the same samples that were analyzed in Fig. 6 (see B i b i k o v a et al., the same issue). Possible increase of isochrone age of granitoids obtained by Rb-Sr method is briefly explained in the above-mentioned paper.

We may give a question, whether this new age determination is not in contradiction with the facts of stratigraphic and especially of palynological research of rocks which are contactly metamorphosed by the granitoids of the Kohút zone, mainly in the complex of the so-called Hladomorná dolina valley or in the region of shaly rock complex of the Brezina type.

In the complex of Hladomorná dolina valley contact metamorphism producing sporadically spotted hornfelses is markedly manifested in some places. Since age of rocks from the Hladomorná dolina valley was palynologically determined as the Silurian to Middle Devonian (K l i n e c — P l a n d e r o v á, 1981), Devonian determination of age of granitoid rocks from the Kohút zone is not in contradiction with stratigraphy of less metamorphosed shales of the Hladomorná dolina valley crystalline complex, if the Silurian is taken for the lower boundary. Formation of hornfelses may imply also the fact that intrusion of granitoids rose to higher, less overheated horizons of the sequence. However, contact metamorphism was caused most probably by younger granitoids of the

Table 4

Isotopic-analytical data on granitoids from the Kohút Veporic zone — Sinec (Rimavica) type (region of Chyžné village)

Sample number	Rb ppm	Sr ppm	$^{87}Rb\ ^{86}Sr$ at. ratios	$^{87}Sr\ ^{86}Sr$ at. ratios
D-1	102.97	344.94	0.866	0.7122
	101.62	338.84		0.7115
D-2	118.36	273.02	1.257	0.7143
	118.57	272.40		0.7143
D-3	118.18	234.27	1.466	0.7150
	119.14	234.16		0.7151

Equation of regression line represents an isochrone $Y = (0.7072 \pm 0.0008) + (0.005450 \pm 0.00068)\ X$. $T = 384 \pm 48$ m. y. Errors are determined for 1σ level. $\lambda\ (^{87}Rb) = 1.42 \times 10^{-11}$/yr.

D-1 wall exposure in cutting of road from Chyžné to Kozia dolina valley, 110° 2 km from elev. point 932 m (Dachov diel), N of Chyžné village;
D-2 ditto as ZK-67 — muscovite-biotite granodiorite, Lubeník, quarry near dam, Kohút Veporic zone, 119°/3.2 km from Revúca village;
D-3 wall exposure 3 × 5 m in road cutting ca. 2 km N of road junction beyond Chyžné, 255°/1.8 km from elev. point 870 m (Ostrý vrch hill).

Rochovce type and other types forming smaller bodies whose age has not yet been determined (see Fig. 2, K l i n e c in M a h e ľ, 1986).

Conclusions

In the paper the authors present four Rb-Sr isochrones which prove, in contrast to the existing views and data, that granitoids of the Kohút zone (the southern part of the Veporic zone) including the so-called Sinec (Rimavica) granite (392 ± 5 m. y.) have a similar age as granitoids of the Sihla type (387 ± 27 m. y.) (see Fig. 3). These conclusions do not refer to leucocratic granitoids of the Vepor (Ipeľ) type which are younger (284 ± 22 m. y.) (Fig. 4), i. e. they may be of the Lower Permian to post Middle Carboniferous age. It has been stated that for the time being we have not analyses of younger granitoids forming projections to the basic rock types of the Sihla, Vepor and Ipeľ types.

Granitoids of the Kohút zone metamorphosed the rocks of the Hladomorná dolina valley whose sequence was palynologically determined as the Silurian to Middle Devonian or the rocks of the Brezina type of the Silurian – Lower Devonian age. This determination of the rocks from the Hladomorná dolina valley and from the sequence of the Brezina type is not in contradiction with the Lower Devonian age of granitoids of the Sihla type or the Kohút zone, if the lower boundary of stratigraphic determination is accepted. If hornfelsic metamorphites which were determined as younger (Upper Carboniferous to Permian) occur near the contacts of shales cut by small apophyses and veiny projections of

leucocratic granitoids, then these granitoids must be of younger age. It has been mentioned that their radiometric age is being determined at present. These granitoids correspond probably also to the bodies bored by borehole at Rochovce, but there are also other similar types of younger granitoids often cutting the basic rock types and occurring also in other places of the Veporic zone.

On the basis of low values of initial isotope ratio $(^{87}Sr/^{86}Sr)_0$ the following interpretation, though hypothetical conclusions may be made:

a) Increased direct effect of mantle melts on formation of granite melt which is presupposed to be formed on the border of mantle and crust or in the lower to central horizons of the crust. Effect of mantle may be caused by direct upwelling of mantle magmatic mass from mantle environment to the crust.

b) Initial ratio of Sr isotopes might be affected also by specific composition of sediments of detrital (greywacke) character which are petrochemically analogical and which often outcrop to the present surface in the Western Carpathian region. Sodium prevails over potassium and, thus, potassium as a bearer of rubidium is deficient in them. Therefore, potassium and strontium occur in lowered quantities in granitoid rocks of the Western Carpathians.

c) Initial ratio of isotopes may be caused by the fact that lava beds or difused contents of pyroclastic rocks which were the products of basic volcanism of mantle provenance (especially of tholeiite character) were present during remelting of rocks of the lower or central crust. These components caused lowered initial ratio of Sr isotopes $^{87}Sr/^{86}Sr$ during anatexis.

d) Combination of individual above-mentioned assumptions may be taken into consideration too.

We presume that main reason of rock variability was crystallization differentiation, whereby the processes of cumulative crystallization may be applied in various degree. Such melt was submitted to differentiation process what affected potassium and other elements contents in some acid rock types.

From the obtained values of initial ratios (I_{Sr}) of the Veporic granitoids an important difference between the Sihla type having the lowest value (I_{Sr} = $= 0.7054 \pm 0.0003$) and the Sinec (Rimavica) type whose $I_{Sr} = 0.7080 \pm 0.0003$ belongs to the highest ones among the Tatric and Veporic granitoids follows. Owing to their identical age, an assumption that granites of the Sinec (Rimavica) type were formed from different, better matured source material with slightly raised Rb Sr ratio seems to be the most suitable. In contrast to it, granites of the Vepor (Ipeľ) type distinguished directly amidst the Sihla type do not differ significantly from the former in I_{Sr} value, though they are younger.

At the same time, we draw an attention to a considerable effect of the superposed processes on determination of isochrone age of rocks by Rb-Sr method. Therefore, the analyzed rocks should be studied also petrographically and, simultaneously, at least by two methods (U-Pb, Rb-Sr).

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