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Rb-Sr ISOCHRONE DATING OF GRANITOIDS FROM TRÍBEČ MTS.

(2 Figs., 1 Tab.)

Abstract: The authors present in the paper the results of Rb-Sr isochrone dating of granitoids from the Tríbeč-Zobor crystalline complex region. Whole-rock Rb-Sr isochrone indicates an age of 352 ± 5 m.y., the initial ratio being $(^{87}Sr/^{86}Sr)_0 = 0.70582+0.00008$, which is similar to the hitherto published initial ratios from the Tatric-Veporide part of the crystalline complex. This indicates a common source of granitoid rocks in all studied region.

Резюме: Автори приводят в настоящей статье результаты Rb-Sr изохронового датирования гранитоидов из Трибечско-Зоборского кристаллиникума. Rb-Sr изохрона из породы указывает на возраст 352 ± 5 м. л., при первичном отношении $(^{87}Sr/^{86}Sr)_0 = 0,70582 \pm 0,00008$, которое соответствует первичным отношениям из татридно-вепоридной части кристаллиникума опубликованным до сих пор. Это указывает на совместный источник гранитоидных пород в изучаемом регионе.

Introduction

Rb-Sr isochrone datings of Western Carpathian crystalline complexes are carried out above all on the basis of a cooperation of the Armenian Academy of Sciences with Geological Institute of the Slovak Academy of Sciences. The recently published summaries of hitherto realized Rb-Sr isochrone datings showed among other things also an absence of this type of data from Tríbeč Mts. (Cambel et al., 1988; Cambel – Kráľ, 1989). This paper is thus a following of previous works on isotopes in Western Carpathians and it fills a gap in the knowledge of Tríbeč Mts.

The determination of age of Tríbeč granitoids was in the beginning based only on geological and petrographical observations (Krist, 1960). The basis of these considerations was the fact that verrucano sediments in Tríbeč Mts. – arkoses to conglomerates – contain already material from granitoid rocks and thus they are an evidence of the granitoid massif having been exposed already in the Permian. Analogies with other Tatride regions of Western Carpathians allowed then to assume that granitoid magmatism in Tríbeč Mts. is related to the culmination of Variscan orogeny and thus it is of Carboniferous age.

This assumption was later supported also by model U-Pb zircon age of 295 m.y. (Cambel et al., 1977) and it was corroborated above all by U-Pb concordant age of zircons (306+10 m.y.) in biotite tonalite with amphibole occurring near Kostoľany pod Tríbečom (Broska – Bibikova et al., 1990).

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Geological setting

Tríbeč Mts., situated on the inner side of Tatricum, is one of the core mountain ranges of Western Carpathian crystalline complexes. It is divided by the Skýcov Fault into in the north-east lying Rázdiel Block and south-western Tríbeč-Zobor Block. Our studies concern the Tríbeč-Zobor Block which, in contrast to the Rázdiel Block formed above all by metamorphites with a considerable participation of diaphtoritic rocks, consists mostly of granitoid rocks with inferior presence of rocks of the metamorhic mantle (Fig. 1).

Granitoids in Tríbeč Mts. form the large but relatively monotonous Tríbeč-Zobor Massif with a prevalence of tonalites (Krist, 1960, a,b). The basic type – biotite tonalite (according to Krist quartz diorite) occurs most frequently especially in the lower part of the intrusion,

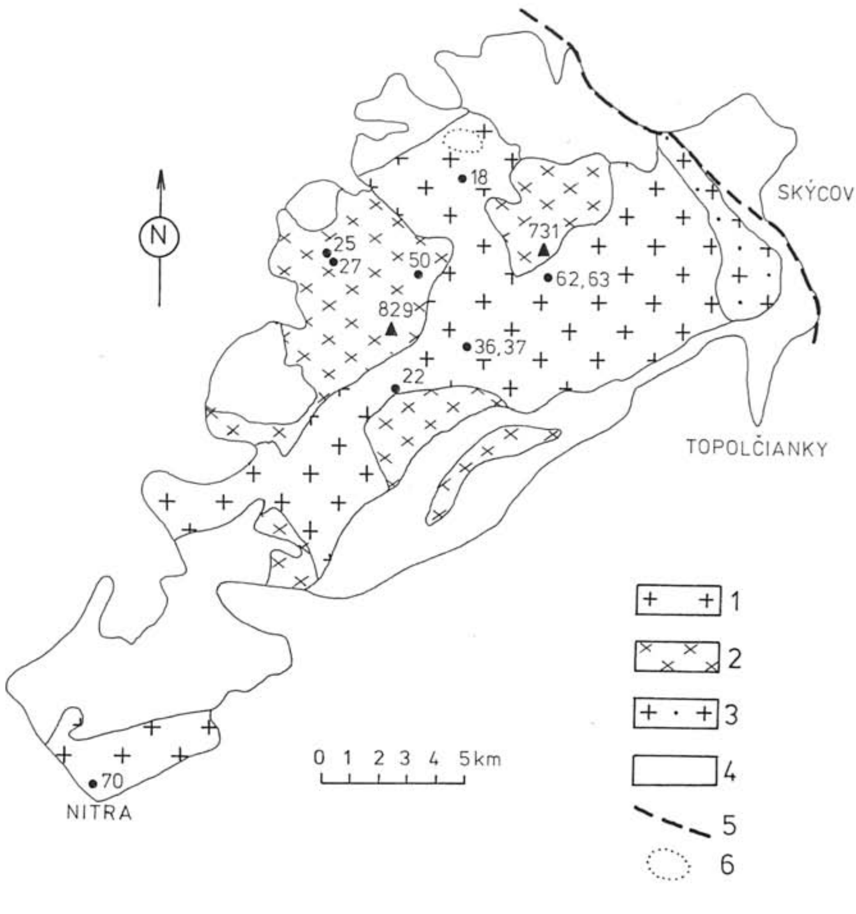

Fig. 1. Schematic geological map of the Tríbeč-Zobor crystalline complex.
1 – coarse-grained tonalite to granodiorite (basic type): 2 – medium-grained tonalite to granodiorite (basic type): 3 – leucocratic muscovite and two-mica granite: 4 – Mesozoic rocks (mostly quartzites): 5 – Skýcov Fault: 6 – area with exposed metamorphic mantle.

while the upper parts of the massif are composed mainly of medium-grained biotite granodiorites. The quartz diorite variety is characterized by a deficit of vein derivates and higher magmatic differentiates are in Tríbeč Mts. developed predominantly in the form of leucocratic granites in the area of Laket' and Skýcov. Accessory minerals of quartz diorite have been characterized by Hovorka (1968), later by Gbelský (1982).

Later on the granitoids of Tríbeč Mts. were characterized only marginally, even in the conception of study of Western Carpathian granitoids (Cambel, 1982). Macek et al. (1982) characterized in their work the basic type in Tríbeč Mts., and, according to the IUGS classification, called it already biotite tonalite.

A new feature in the study of granitoids in Tríbeč Mts. was the acceptance of the idea of coexistence of intermediary and acid magma in the Tríbeč-Zobor granite pluton (Petrík – Broska, 1989). According to these authors, intermediary magma is now represented only by mafic enclaves, but this does not prevent the authors from assuming that it was this intermediary magma which initiated the melting of acid magmas and thus gave an impulse to the formation of granitoids in which the enclaves are situated. This above cited work also characterized the basic type, but above all, in detail, the enclaves, which were captured as melts from a deeper lying magmatic source.

For the purpose of Rb-Sr isochrone dating we collected the widest possible range magmatic differentiates in the whole massif. The samples T-22, 36, 63, 70 represent the basic type of granitoids described by Krist (1960a) as quartz diorite and according to IUGS classification later classed as biotite tonalite. They are coarse-grained rocks, affected by relatively intensive subsolidus alterations like sericitization and saussuritization of plagioclases, chloritization and epidotization of biotites etc.. The sample T-62 represents a mafic enclave in the basic granitoid variety. The rest of the samples are higher magmatic differentiates, while some of them (T-37, 50) occur as veins.

The samples for Rb-Sr isochrone dating were collected in two stages. 7 samples were evaluated in the first stage, further 3 samples (T-25, 50, 70) were added in the second stage, since the first 7 samples showed small variance of Rb-Sr contents.

Description and location of the samples:

T-18 – *biotite granodiorite,* Krnča, outcrop near a timber-slide to Ostrá Hôrka Hill. 10°/800 m from the elev. p. 446 Ostrá Hôrka Hill.

T-22 – *biotite tonalite* with amphibole. Kostoľany pod Tríbečom. Old quarry on the road Jelenec-Zlatno. 350°/300 m from the elev. p. Malá Kurňa.

T-25 – *leucocratic monzogranite.* Kovarce, timber-slide to Malá Kurňa. Outcrop 600 m NW from Malá Kurňa (310°/600 m from the elev. p. 465 m).

T-27 – *leucocratic muscovite monzogranite.* Kovarce, on the timber-slide from Čeľadince to Malá Kurňa 300°/300 m from the elev. p. 465 m.

T-36 – *biotite tonalite.* Velčice, near the red-sign tourist path, small cliff. 280°/750 m from the elev. p. Kozlišov.

T-37 – *granite* (vein in biotite tonalite T-36). The same as T-36.

T-50 – *leucocratic monzogranite.* Solčany, 1.8 km above the Dekan lodge, the road to the right, old quarry.

T-62 – *biotite tonalite.* Zlatno, 1500 m S of the elev. p. 731 m Javorový Hill. (Enclave in basic granitoids type).

T-63 – *biotite tonalite.* Zlatno, 1500 m S of the elev. p. 731 m Javorový Hill.

T-70 – *quartz diorite.* Nitra. Old quarry with a lake under the funicular to Zobor.

Results of Rb-Sr isotopic study

The evaluation of experimental data of the first 7 samples (first group) by polynomial method of least squares leads to the regression equation

$$Y = 0.70581 + 0.00502\ X$$

which corresponds to the age of T = 353±7 m.y. and initial ratio $(^{87}Sr/^{86}Sr)_0$ = 0.70581±0.00009. However, the average squared weighted deviation (ASWD) is equal to 13.43 and thus it considerably exceeds 1. This means that the residual variance is greater than experimental variance and it contains a component related to geochemical effects. If we exclude hybrid character ot the rocks, we have to admit that the rocks underwent a process of negligible redistribution of Sr after crystallization. In any way, the considerable spreading of the isochrone and the location of 6 points about the origin of coordinates allow to determine the age as well as the initial ratio $(^{87}Sr/^{86}Sr)_0$ with sufficient accuracy.

Experimental data on the three new samples from the Tríbeč granitoid massif have been evaluated separately. Polynomial method of least squares produced an isochrone (ASWD = 0.574) corresponding to the age of T = 351±6 m.y., at the initial ratio $(^{87}Sr/^{86}Sr)_0$ = 0.70579+0.00017. This result practically does not differ from the earlier obtained one and thus it is possible to evaluate the experimental data on all 10 samples together. In this case T = 352±5 m.y., at the initial ratio $(^{87}Sr/^{86}Sr)_0$ = 0.70582±0.00008. However, here similarly as in the first case, the average squared weighted deviation considerably exceeds 1 (ASWD = 8.49).

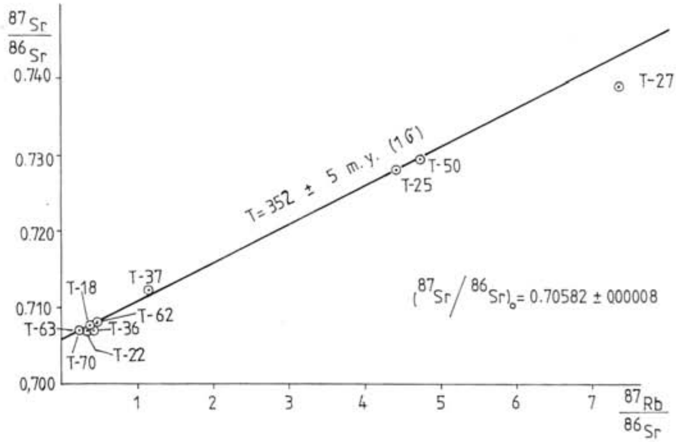

Fig. 2. Whole-rock isochrone constructed from data on granitoid rocks of the Tríbeč-Zobor crystalline complex.

The exclusion of some samples from the evaluation basically does not change the result. Thus, the exclusion of the samples T-27/86 and T-37/86 leads to the result T = 353.4±5.8 m.y. and $(^{87}Sr/^{86}Sr)_0$ = 0.70563±0.00008. However in this case ASWD = 2.38 and since it is statistically less than one, the isochrone model is here evident (Fig. 2, Tab. 1).

Table 1
Rb-Sr isotopic-analytical data on granitoids of Tríbeč Mts.

Sample No.	Rb Mg/g	Sr Mg/g	$^{87}Rb/^{86}Sr$ atom. r.	$^{87}Sr/^{86}Sr$ atomic ratio
T-18/86	56.80	464.92	0.350	0.70752 ± 0.00017
	55.79			0.70768 ± 0.00008
T-22/86	81.85	782.99	0.302	0.70688 ± 0.00025
				0.70631 ± 0.00013
T-27/86	153.71	60.45	7.356	0.73908 ± 0.00020
				0.73981 ± 0.00016
T-36/86	75.92	607.94	0.351	0.70725 ± 0.00038
	72.53	614.34		0.70715 ± 0.00006
T-37/86	83.58	209.78	1.153	0.71241 ± 0.00011
				0.71222 ± 0.00003
T-62/86	119.56	750.85	0.448	0.70781 ± 0.00018
				0.70739 ± 0.00037
T-63/86	73.66	830.42	0.257	0.70693 ± 0.00025
				0.70713 ± 0.00011
T-50/86	140.63	87.11	4.678	0.72888 ± 0.00018
T-25	147.10	97.40	4.367	0.72780 ± 0.00015
T-70	67.93	763.93	0.257	0.70707 ± 0.00016

Note: The values of the error of the ratio $^{87}Sr/^{86}Sr$ represent the average squared deviations.
The variation coefficient of the determination of $^{87}Rb/^{86}Sr$ is ⟨ 2.0 %.
The decay constant of λ $^{87}Rb = 1.42 \times 10^{-11}$ y $^{-1}$.

Conclusion

Rb-Sr isochrone method allowed to determine the age of the Tríbeč-Zobor granite massif, its value being 352±5 m.y. The initial ratio $^{87}Sr/^{86}Sr = 0.70582 \pm 0.00008$ corresponds to the hitherto obtained results from the Tatric-Veporide region, which indicates that the source rocks of granitoids were similar in all region (Cambel – Kráľ, l.c.), as well as crustal character of the granitoids.

The age determined by Rb-Sr method is at considerable variance to the determinations by U-Pb zircon method carried out on biotite tonalite near Kostoľany pod Tríbečom, resulting in the age 306±10 m.y. (Broska – Bibikova et al., 1990). Similar contradictions, when U-Pb age on zircons is lower than Rb-Sr age, have already been observed in the Sinec granite (Bibikova et al., 1988; Cambel et al., 1988) and Sihla granite (Bibikova et al., 1990). This paper does not have the aim to find the reasons for the discrepancies in zircon U-Pb and whole-rock Rb-Sr ages, since this is a rather complicated problem requiring more petrological and geochronological data. However, we assume that certain controversies in Rb-Sr dating can be a result of the considerable mobility of alkali metals including Sr in postgenetic processes (Lutz – Srogi, 1986; Shcherbak et al., 1990), or of mixing of source materials with different initial Sr isotopic ratios (Cambel – Kráľ, l.c.).

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