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GRANITIC PEBBLES OF THE CRETACEOUS FLYSCH OF THE PIENINY KLIPPEN BELT, WESTERN CARPATHIANS: U/PB ZIRCON AGES

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Abstract: Five zircon concentrates from three occurrences of "exotic" granitic pebbles (Upohlav type) in the Pieniny Klippen Belt Cretaceous flysch sequences (the Klape and Pieniny Units) underwent U/Pb isotopic age determination. The U/Pb discordia data have the upper intercept with concordia at 274 ± 13 Ma, the 207/206 vs. 204/206 lead data gave 294 ± 21 Ma. These results are interpreted as the age of primary magmatic crystallization of the Lower Permian Variscan post-orogenic and A-type trending granitic suite. In addition, the present results contradict older opinions (Birkenmajer 1988; Mišík & Marschalko 1988) about the Jurassic-Cretaceous ages of "exotic" acid magmatites based on K/Ar dating, which are newly interpreted as the uplift ages.

Key words: Western Carpathians, Pieniny Klippen Belt, Klape and Pieniny Units, Cretaceous flysch, granitic pebbles, U/Pb zircon ages.

Introduction

The abundant presence of various "exotic" rock pebbles, especially conspicuous granites and granite porphyries from Middle to Late Cretaceous (to Paleogene in E Slovakia and Ukraine) flysch sequences of the Pieniny Klippen Belt (PKB) has attracted a lot of attention from Carpathian geologists (e.g. Zoubek 1931; Wieser 1958; Krivý 1969; Chernov 1973; Kamenický et al. 1974; Šímová 1985; Marschalko 1986; Mišík & Marschalko 1988; Birkenmajer 1988; Birkenmajer & Skupinski 1989). These authors stated their "exotic" character in comparison to the Western Carpathian Variscan granitoids (the Tatric and Veporic Units). K/Ar isotopic data for these "exotic" granitic pebbles gave Jurassic - Cretaceous ages (Chernov l.c., Rybár & Kantor ex Marschalko l.c.) which were interpreted as the magma crystallization ages. Consequently, some authors used these data as a proof of the existence of Paleoalpine island-arcs or active continental margin subduction magmatism (e.g. Marschalko l.c.; Birkenmajer l.c.).

On the basis of recent geochemical and mineralogical studies (Uher & Marschalko 1993; Uher et al. 1994) the Upohlav type "exotic" granitic rocks rank among post-orogenic mildly alkaline A-type trending suite with an expected post-Variscan (Permian) age. Our U/Pb zircon data presented in this contribution support this assumption.

Characteristics of the samples

Five samples from three conglomerate occurrences were selected for zircon isotopic analyses (Fig. 1). They are 5 - 7 kg weight large pebbles (blocks) of the Upohlav type granitic rocks (Uher & Marschalko 1993) from the Klape and Pieniny Units of the Pieniny Klippen Belt flysch sequences (Albian to Maas-

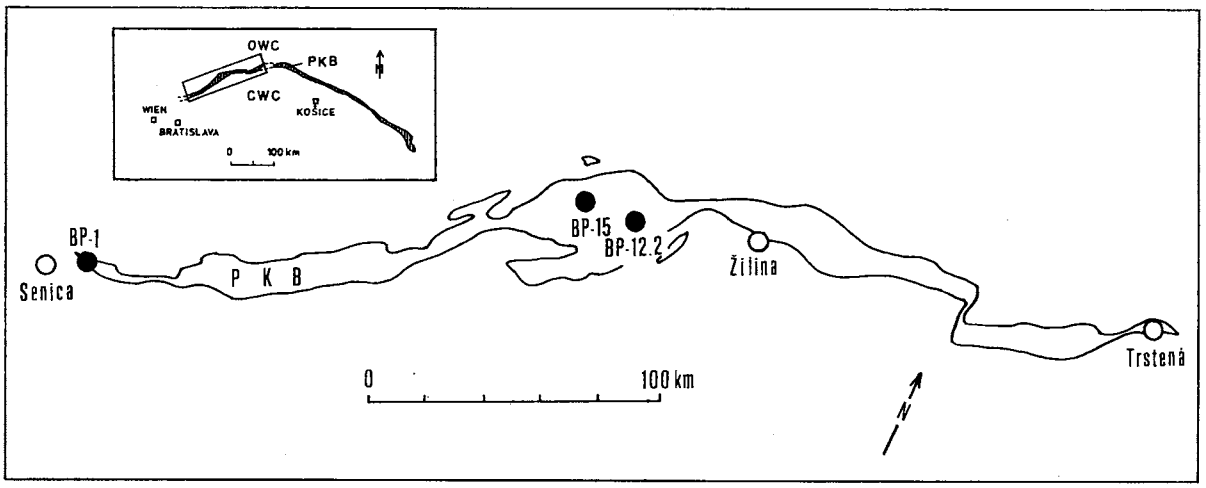

Fig. 1. The position of studied samples in the Pieniny Klippen Belt (PKB). OWC - Outer Western Carpathians, CWC - Central Western Carpathians.

trichtian). For geological details see the works of Marschalko (1986) and Mišík & Marschalko (1988). The petrographical and geochemical characteristics of the granitoids are given in a paper by Uher et al. (1994). The accessory zircon occurs as up to 0.5 mm long, light pink to yellow transparent crystals with regular oscillatory zoning without old (relict) cores, P_{4-5} to D typology and with 1 - 2 wt. % of HfO_2 (Uher & Marschalko l.c.). A brief description of the studied samples follows (with IUGS classification rock names used):

BP-1 - Leucocratic biotite granite (33.1 quartz, 41.2 K-feldspar, 21.5 plagioclase, 3.4 biotite, 0.7 muscovite and 0.1 accessory minerals - in vol. %) from Podbranč village, Starý Hrad Hill, about 70 km NNE from Bratislava. Pebble from Santonian age conglomerates of the Pieniny Unit (Marschalko 1986).

BP-12.2 - Leucocratic granite porphyry (86.1 quartz-feldspar granophyric matrix, 4.8 K-feldspar, 0.3 plagioclase, 1.8 biotite, 3.0 muscovite and 4.1 secondary calcite - in vol. %) from Považská Bystrica - Vrtižer village, Chrasť Hill, about 150 km NE from Bratislava. Pebble from Santonian age conglomerates of the Klape Unit (Marschalko l.c.).

BP-15 - Leucocratic biotite granite (29.3 quartz, 38.6 K-feldspar, 26.5 plagioclase, 3.3 biotite, 0.1 muscovite, 0.2 accessory minerals and 2.1 secondary calcite - in vol. %) from Upohlav village, outcrops ca. 300 m W from village, about 145 km NE from Bratislava. Pebble from Albian age conglomerates of the Klape Unit (Marschalko l.c.).

Analytical techniques

The age determinations were carried out at the Department of Isotope Geology of the All Russia Science Research Geological Institute (VSEGEI), St.-Petersburg. Two zircon size fractions were used: 0.05 - 0.1 mm and <0.05 mm, in the BP-1 sample only <0.1 mm. The Finnigan MAT-261 multicollector mass-spectrometer was used. The decay constants used for calculations are those recommended by the Subcommision on Geochronology (Steiger & Jäger 1977). For the common lead correction an isotopic composition according to the two-stage model of Stacey & Kramers (1975) was assumed with $(^{206}Pb/^{204}Pb)_0 = 18.3$ and $(^{207}Pb/^{204}Pb)_0 = 15.6$ values for ca. 250 Ma age. For the calculation of the radiogenic isotope ratios the Pb composition was corrected by 0.3 ± 0.15 ppb Pb-Blank and 0.13 ± 0.03 % per atom unit for mass-discrimination.

Results and conclusions

The results of isotopic composition and U/Pb age determinations are presented in Tab. 1 and Figs. 2 and 3.

The Upohlav type pebbles of granitic rocks have a concordia upper intercept age of 274 ± 13 Ma (2σ, MSWD = 1.8) which is interpreted as the primary crystallization age of the magma. The lower intercept 94 ± 88 Ma is probably without real geological significance. The $^{207}Pb/^{206}Pb$ vs. $^{204}Pb/^{206}Pb$ isochron determination according to Tera & Wasserburg (1974) modification gave a slightly older age 294 ± 21 Ma (2σ, MSWD = 0.63).

Consequently, the results of age determinations indicate uppermost Carboniferous to Lower Permian ages. The late to post-Variscan age of the Upohlav type granite pebbles is not surprising, since the zircon typology and geochemical features, especially the trace-element pattern indicate post-orogenic A-type trending granitic suite (Uher & Marschalko 1993; Uher et al. 1994) with many analogies with European Permian (sub)alkalic magmatites (cf. Bonin 1990). On the basis of recent mineralogical, geochemical and partly geochronological data, similar mainly Permian Variscan post-orogenic granitic rocks also occur in the Western Carpathian area. They are the Hronček granites in the Veporic Unit with 260 Ma zircon age (Cambel et al. 1977) and 285 ± 5 Ma, resp. 253 ± 2 Ma Rb/Sr isochron ages (Cambel et al. 1989), the Turček Granite in the Gemeric Unit (Uher & Gregor 1992) and probably the Rochovce Granite in the Veporic - Gemeric contact zone (Határ et al. 1989). However, the Rochovce Granite gave ambiguous Rb/Sr results: the Late Permian, 253 ± 2 Ma rock isochron age (Cambel et al. 1989), but even Cretaceous, 101 ± 5 Ma WR-mineral age (Kováč et al. 1986). The Sn-bearing granites in the Spišsko-Gemerské Rudohorie Mts. with specific geochemical features also rank

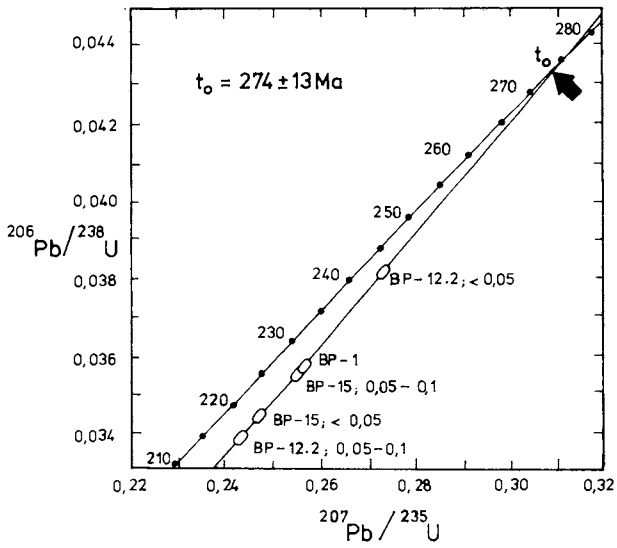

Fig. 2. The $^{206}Pb/^{238}U$ vs. $^{207}Pb/^{235}U$ discordia diagram of the Upohlav type pebbles of granitic rocks.

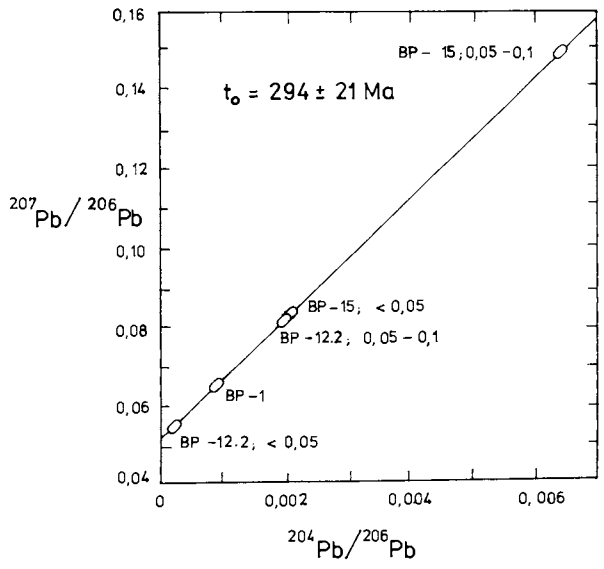

Fig. 3. $^{207}Pb/^{206}Pb$ vs. $^{204}Pb/^{206}Pb$ isochron diagram of the Upohlav type pebbles of granitic rocks.

Table 1: Isotopic U/Pb data of the Upohlav type pebbles of granitic rocks.

Sample	size (mm)	U (ppm)	Pb (ppm)	measured ratios (Pb/Pb)		
				206/204	206/207	206/208
BP-1	<0.1	1385.7	54.63	1048.79±4.720	15.16298 (91)	5.05739 (15)
BP-12.2	0.05-0.1	1438.3	57.72	488.028±0.626	12.18224 (41)	4.15991 (15)
BP-12.2	<0.05	801.7	33.40	3273.4±32.8	17.74893 (89)	4.76079 (333)
BP-15	0.05-0.1	486.6	26.66	149.116±0.124	6.66508 (65)	2.38120 (238)
BP-15	<0.05	761.1	31.48	444.700±4.450	11.76870 (88)	3.86909 (193)

Sample	size (mm)	Pb isotopic composition (%)				calculated ratios (Pb/U, Pb/Pb)		
		204	206	207	208	206/238	207/235	207/206
BP-1	<0.1	0.071	79.20	5.17	15.56	0.03569	0.25661	0.05215
BP-12.2	0.05-0.1	0.15	75.54	6.18	18.13	0.03394	0.24684	0.05275
BP-12.2	<0.05	0.017	79.18	4.37	16.44	0.03818	0.27398	0.05205
BP-15	0.05-0.1	0.42	63.66	9.43	26.49	0.03559	0.25234	0.05142
BP-15	<0.05	0.16	74.62	6.21	19.01	0.03445	0.24604	0.05180

Sample	size (mm)	apparent ages (Ma)		
		206/238	207/235	207/206
BP-1	<0.1	226	232	292
BP-12.2	0.05-0.1	215	224	318
BP-12.2	<0.05	242	246	287
BP-15	0.05-0.1	226	229	260
BP-15	<0.05	218	223	277

among Permian late to post-Variscan intrusions (Kovách et al. l.c.; Cambel et al. l.c.).

Similar Upper Carboniferous to Permian post-orogenic A-type trending granitic rocks also occur in the adjacent Transdanubian Central Range (the Velence Mts., Hungary - Uher & Broska, in press) and in the Eastern Alps (Finger et al. 1992). Permian alkalic granites are widespread in the whole Western Mediterranean area (Bonin 1990).

On the other hand, the present zircon data contradicts the older opinion about the Jurassic to Cretaceous, ca. 140 - 90 Ma ages of the "exotic" Upohlav type acid magmatites based on K/Ar rock data (Chernov 1973; Rybár & Kantor 1978 ex Marschalko 1986). These young K/Ar ages can be interpreted as an uplift event during the Paleoalpine Neokimmerian (Upper Jurassic - Lower Cretaceous) tectonoactivity, which is a typical feature of the Inner Carpathian Units, e.g. Silica, Meliata and Bükk (Maheľ 1986). Consequently, the broader Inner Carpathian, South Alpine (Dinaric) or their equivalent zones may have represented possible source areas for granitic and others "exotic" pebbles of PKB flysch sequences.

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