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The Age of the Thaya (Dyje) Pluton

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With 4 figures and 2 tables

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Summary

Whole rock samples of the Thaya (Dyje) pluton from the Moravian Zone of the Bohemian Massif were investigated by the Rb-Sr method. The isochron defines an age of 551 ± 6 m. y., the initial Sr ratio of $.70961 \pm .00034$ points to crustal origin. The emplacement occurred in the course of the cadomian cycle.

Zusammenfassung

Gesamtgesteinsproben des Thaya (Dyje) Plutons im Moravikum der Böhmischen Masse ergaben mit der Rb-Sr Methode ein Alter von 551 ± 6 Mio. J. Das initiale Strontiumverhältnis von $.70961 \pm .00034$ weist auf eine Entstehung in der Kruste hin. Die Platznahme erfolgte während der cadomischen Orogenese.

The granitoid body of the Thaya (Dyje) batholith is part of the Moravian Zone, the southeasternmost unit of the Bohemian Mass. It shows a bent lenticular shape extending from Czechoslovakia to Austria in NE—SW direction. It covers an area of approximately 600 km² (fig. 1). More than two thirds are overlain by tertiary and unmetamorphosed paleozoic sediments. Towards the west it borders the so called Inner Phyllites of the Moravikum. The contact is supposed to be of intrusive nature, but in places (Czechoslovakia) it seems to be a tectonic one. On the eastern rim, covered by tertiary sediments, one assumes a NNE—SSW striking fault, a continuation of the Boskovice Furrow. It separates the batholith from rocks of the Krhovice Crystalline. This lineament, a wrench fault, has also separated the Thaya batholith from the pluton of Brno in the northeast.

The Thaya batholith has undergone metamorphism whose intensity decreases from west to east. In the western border zone the rocks can be classified as blastomylonitic granites. Towards the east the schistosity is less and less developed. There the deformation caused cataclasis with varying intensity. The magmatic mineral assemblages consisted of zoned plagioclase (calcic oligoclase), alkalifeldspar, quartz,

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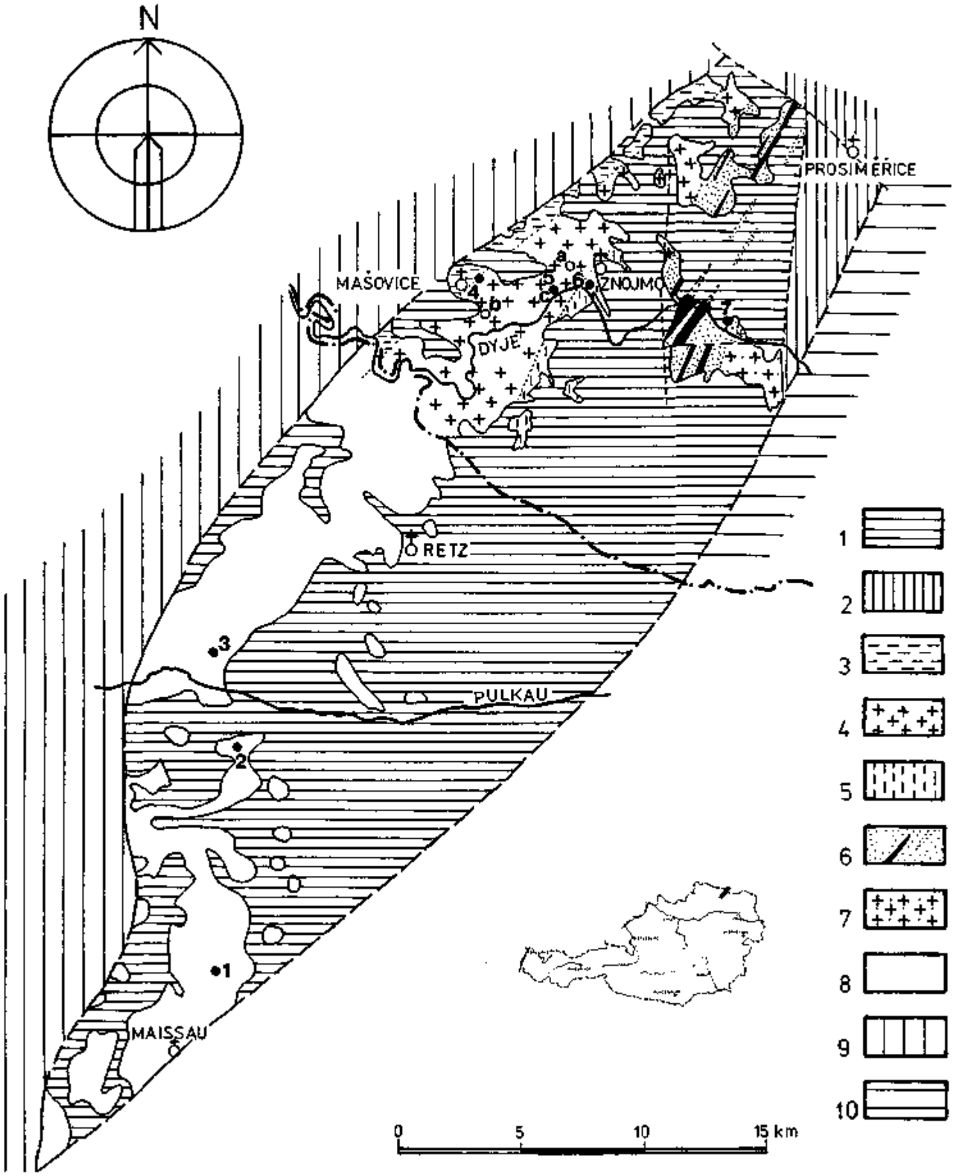

Figure 1: Geological sketch map of the Thaya (Dyje) batholith

1: Quarternary and Tertiary. — 2: Assumed area of Paleozoic. — 3: Granite blastomylonite. — 4: Schistose granite. — 5: Cataclastic granodiorite. — 6: Granitoid with inclusions of biotite and amphibole bearing quartz diorites to tonalites. — 7: cataclastic granitoid of type Tasovice. — 8: undifferentiated granitoid rocks in the Austrian part of the pluton. — 9: Inner Phyllites. — 10: Krhovice crystalline complex. — Full circles with numbers: sample localities for Rb-Sr determinations (see appendix). — Open circles with letters: Sample localities for chemical analyses (see appendix) biotite (in places with sagenite), amphibole in some types, apatite, and zircon. The metamorphic assemblages comprise recrystallized quartz, albite, biotite, chlorite, muscovite, titanite, epidote, and garnet in the western parts. In places oligoclase instead of albite recrystallized indicating a higher metamorphic grade. In general strong alteration of the mineral components is typical for the rocks of the Thaya massif.

The rocks of the pluton vary in composition (fig. 2). From modal analyses it is known that the western parts are mainly granitic. Towards the center the plagioclase content increases, the rocks become granodioritic in composition. The granite — granodiorite of Tasovice is regarded as a special facies of the pluton due to its pink colour and fine grained texture.

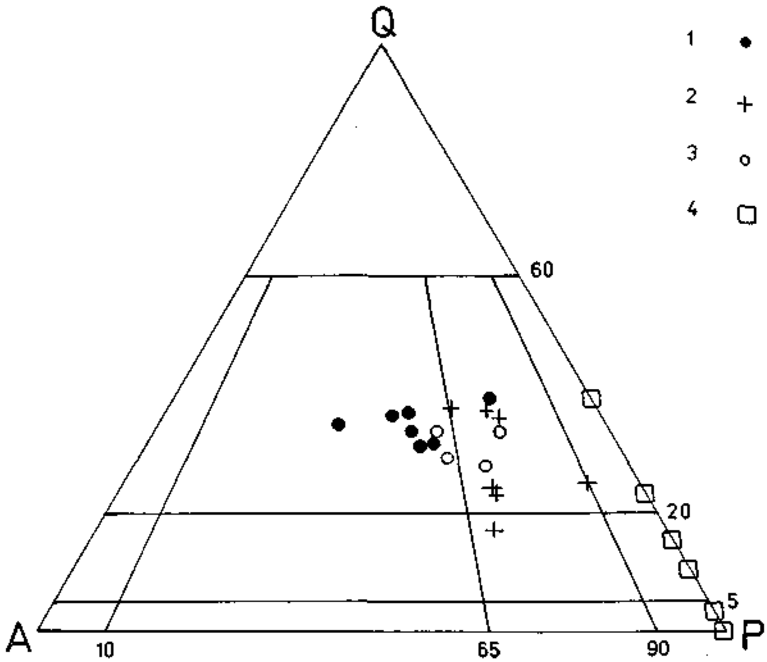

Figure 2: Modal composition of the rocks from the Bohemian part of the Thaya (Dyje) massif plotted in the Q, A, P-diagram after A. Streckeisen, 1977
1: biotite granite. — 2: biotite granodiorite. — 3: biotite granite to granodiorite of the type Tasovice. — 4: biotite and amphibole bearing quartz diorite to tonalite

A zone of elongated bodies of biotite and amphibole-bearing quartz diorites to tonalites (classification according to A. Streckeisen, 1972) is situated close to the eastern rim of the massif. The texture and structure do not yet allow a decision wether these rocks have intrusive origin or represent absorbed parts of the country rocks. Table 1 shows the chemical composition of the main rock type from the western part of the pluton. Additional analyses have been published by K. Preclik, 1937.

The time of intrusion of the Thaya pluton is assumed to be Predevonian. It was already deeply eroded at the time of transgression and deposition of clastic sediments, which at the eastern border probably form the base of Givetian and Frasnian carbonates (P. BATIK & V. SKOCEK, in press). Predevonian emplacement can also be deduced from lithologic and tectonic analogies with the Brno pluton and the granite of the Svratka Core which are overlain by Devonian conglomerates.

Few radiometric data point to a cadomian (assyntian) event. An amphibole from a quartz diorite from the basic intercalations mentioned above was analysed at the laboratories of Ústřední ústav geologický, Praha. It yielded a K-Ar age of 630± 50 m. y. Biotites and some amphiboles of diorites from the southern Moravian block recovered from boreholes drilled through the Carpathian Foredeep and the Flysch nappes gave K-Ar ages between 555 and 605 m. y. and even higher (A. DUDEK & J. MELKOVA, 1975).

Table 1: Chemical analyses of granites from the Thaya (Dyje) Massif. a, b and c refer to the localities plotted in figure 1

	a	b	c
SiO_2	71,85	73,50	71,50
TiO_2	0,24	0,16	0,24
Al_2O_3	14,92	14,67	14,78
Fe_2O_3	0,52	0,54	0,53
FeO	1,46	0,92	1,54
MnO	0,06	0,05	0,07
MgO	1,14	0,97	2,14
CaO	1,43	1,25	0,22
Na_2O	4,23	4,33	3,77
K_2O	3,52	3,01	3,85
P_2O_5	0,05	0,05	0,04
CO_2	0,08	0,08	0,10
H_2O^+	0,54	0,34	0,51
S	tr.	—	—
H_2O^-	0,09	0,07	0,12
	100,13	99,97	99,41

Table 2: Rb-Sr analytical data of whole rock samples from the Thaya (Dyje) batholith

Sample number	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$	$^{87}Sr/Sr^{86}$	
AB 120	105	353	.861	.71630± 40*	
AB 122	106	342	.894	.71667±118*	
AB 99	137	322	1.229	.71913± 8	.71926± 63*
AB 94	150	327	1.332	.72006± 12	.71999± 36*
AB 101	131	284	1.335	.72035± 50*	
AB 90	151	327	1.343	.71990± 22	.71985±218*
AB 89	150	314	1.383	.72043± 9	.72054 *
AB 98	152	302	1.458	.72085± 70*	
AB 100	129	241	1.546	.72175± 14	.72187±243*
AB 102	148	233	1.832	.72480± 18	.52488±209*
AB 127	203	168	3.51	.73631± 70*	
AB 125	180	80.0	6.54	.76076± 60*	
AB 124	190	72.6	7.61	.76910± 99*	
AB 123	184	68.8	7.79	.77146± 58*	

* Sr ratios calculated from spiked samples.

The error on $^{87}Rb/^{86}Sr$ is ±1%. The errors on $^{87}Sr/^{86}Sr$ are on the 95% confidence level and refer to the last digits.

For the study presented here fourteen rock samples of various size from seven localities distributed over the entire area (see fig. 1 and appendix) have been analysed by the Rb-Sr method. Rb and Sr have been determined by isotope dilution. The samples have been spiked before chemical decomposition with HF and HNO_3. Rb and Sr were separated from the sample solution after centrifuging by ion exchange, using Dowex 50-X8 for Sr and zirconium phosphate for Rb as resin beds. The isotopic composition is measured with a MM 30 mass spectrometer supplied with a Faraday cup and a Cary 401 amplifier. The isotopic ratios are calculated with an on-line computer PDP 8. The Sr isotopic composition of several samples were also measured on unspiked material and gave excellent agreement with the spiked ones (see table 2). For age calculation and construction of

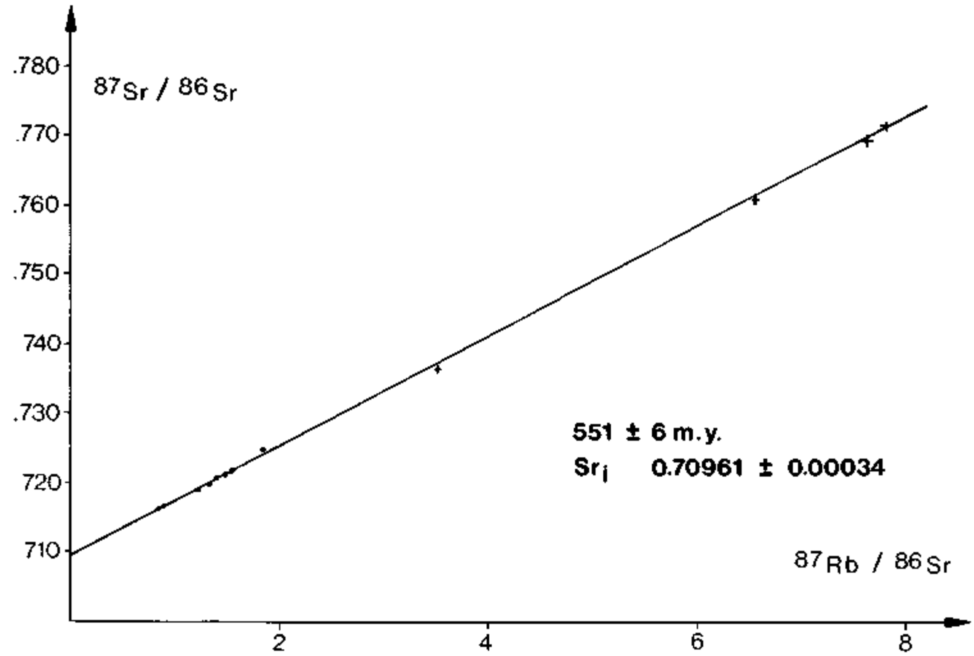

Figure 3: Sr evolution diagramm of fourteen whole rock samples from granitoid rocks of the Thaya (Dyje) pluton. The isochron defines an age of 551 ± 6 m. y., calculated with $\lambda = 1{,}42 . 10^{-11} . a^{-1}$. It is interpreted as the time of emplacement at the Precambrian/Cambrian boundary. The initial Sr ratio of $.70961 \pm 0.0034$ points to a formation within the crust. The errors are 2 σ.

the isochron the values of the unspiked samples have been preferred because of the smaller errors on ^{86}Sr ^{87}Sr. For calculation the atomic ratios and the Rb decay constant $\lambda = 1{,}42 . 10^{-11} . a^{-1}$ given by H. R. Steiger & E. Jäger, 1977 have been used. The Isochron was calculated following the method of D. York, 1969.

The results of the analytical work are documented in table 2 and figures 3 and 4. The slope of the isochron defines an age of 551 ± 6 m. y. with an intercept of $.70961 \pm .00034$. This age represents the time of magma formation and intrusion during the cadomian orogenic cycle. Due to its initial Sr ratio the granite must be of crustal origin.

From the few data so far known we can state that the Thaya pluton represents the youngest member of the rock complexes constituting the Moravicum. Yet little is known about metamorphic processes connected with the cadomian cycle. The hornblende age of 630 m. y. of the dioritic inlayer might point to them if we regard them as reworked country rocks, as well as first results of S. Scharbert on muscovites from the Biteš Gneiss lying in the same range. For the Biteš Gneiss an age of 800 m. y. was obtained (S. Scharbert, 1977). This age of the Biteš Gneiss which was emplaced in a shallower environment could mark the beginning of the cadomian cycle.

Hence, we can conclude that the Moravicum is a crystalline unit of the Bohemian Massif where pre-caledonian events are preserved and can be dated.

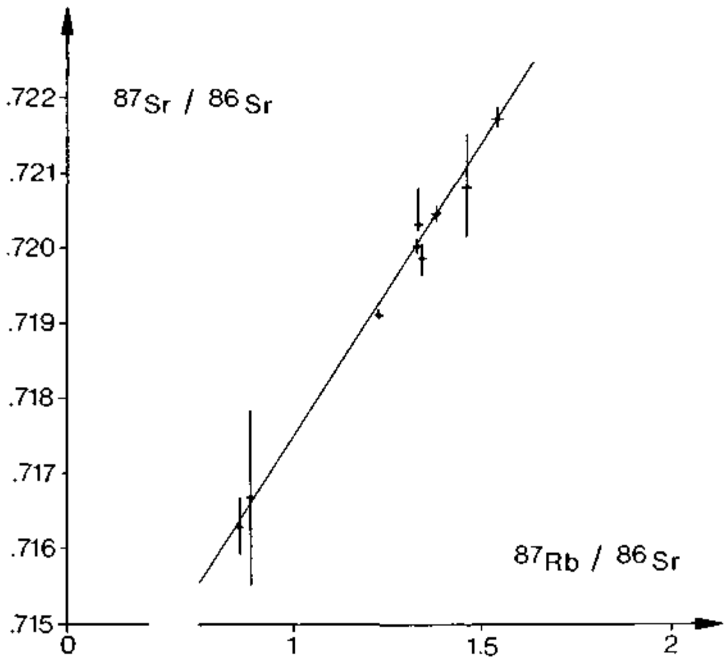

Figure 4: Enlarged section of the Sr evolution diagramm of fig. 3 showing the exact position of the samples with low Rb/Sr ratio

Acknowledgement

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Appendix

Sample location and rock description of samples for radiometric dating (table 2). The numbers refer to the points in figure 1.

1: Quarry in the Gänsgraben, 1 km west of Limberg. Light grey gneissic granite, slightly cataclastic. Feldspars up to 8 mm in length (filled plagioclase, perthititic alkalifeldspar), yellow brown biotites with sagenitic exsolution, colourless chlorite. Samples AB 120 (12 kg), AB 122 (18 kg).

2: Abandoned quarry at Feldberg, 2 km south of Großreipersdorf near Pulkau. Grey granodioritic type with slightly gneissic texture. Feldspars up to 1 cm in length, few relics of brown biotite, green chlorite, rare tiny garnets. Samples AB 123 (17 kg), AB 124 (5 kg), **AB** 125 (8 kg).

3: Road cut 2 km northwest of Pulkau along the road Pulkau—Weitersdorf. Light medium grained metagranite with faint lineation. Biotites often with hexagonal shape. AB 89 (5 kg), AB 90 (10 kg), AB 94 (16 kg), AB 98 (5 kg).

4: Quarry approximately 1 km east of Mašovice. Strongly foliated variety. Rare clusters of biotite, contains also "cross" biotites growing perpendicular to the foliation plane. AB 99 (17 kg), AB 100 (21 kg).

5: Abandoned quarry at the river Dyje southwest of Hradiště. The granite exhibits faint lineation and contains big idiomorphic biotites. AB 101 (15 kg).

6: Road cut in the Dyje valley in Znojmo, 150 m east of the dam. Massive rock with coarse grained biotite. Small muscovites on shear planes. AB 102 (21 kg).

7: Natural outcrop in the Dyje valley appr. 500 m ESE of the village Dyje. Pinkish fine grained variety (type Tasovice) with dark streaks of mylonitic material. AB 127 (2 kg).

Sample location of rocks for chemical analyses (table 1) The letters refer to the open circles in fig. 1.

a: Abandoned quarry at the western rim of Znojmo.

b: Thaya (Dyje) valley, 1.5 km southwest of Znojmo.

c: 1 km southeast of Mašovice.

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