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Rb-Sr Whole Rock Ages for the Biteš-gneiss, Moravicum, Austria

by *W. Morauf** and *E. Jäger***

Abstract

The Biteš-gneiss from the Moravicum and the Plattengneiss from the Koralpe, Eastern Alps, have been compared by geologist because of their similar styles of deformation and direction of the lineation. Following studies in the Koralpe (Alpidic ages) the Rb-Sr age determinations for the Biteš-gneiss have produced Lower Palaeozoic whole rock ages. These results will be discussed in relation to previously published data on the Biteš-gneiss.

INTRODUCTION

The Biteš-gneiss of the Bohemian Massif has been compared by Austrian geologists with the Plattengneiss from the Koralpe, Southeastern Alps (SCHAFFER, 1951). Both rocks are highly tectonised and the strike of the lineation has the same NNE direction. Both units were regarded as Variscan in age.

A recent Rb-Sr whole rock work upon the Plattengneiss (MORAUF, 1982) revealed the whole rock system to have been strongly overprinted in Alpine times. Because of the supposed comparability of the two gneisses, the Biteš-gneiss, which lies outside the Alpine domain, was similarly investigated using Rb-Sr isotope techniques.

Eight samples were collected from five localities in the area of the Biteš-gneiss (map, Fig. 1): Four Biteš-gneiss samples and four samples from intercalated rocks with different chemistry. The latter samples were found in the same quarry (indicated M on the map, Fig. 1) S of Messern. This location is very close to the Western limit of the Biteš-gneiss and near to the thrustline of the Moldanubicum upon the Moravicum. Of these samples three are rich in micas, and one is rich in K-feldspar.

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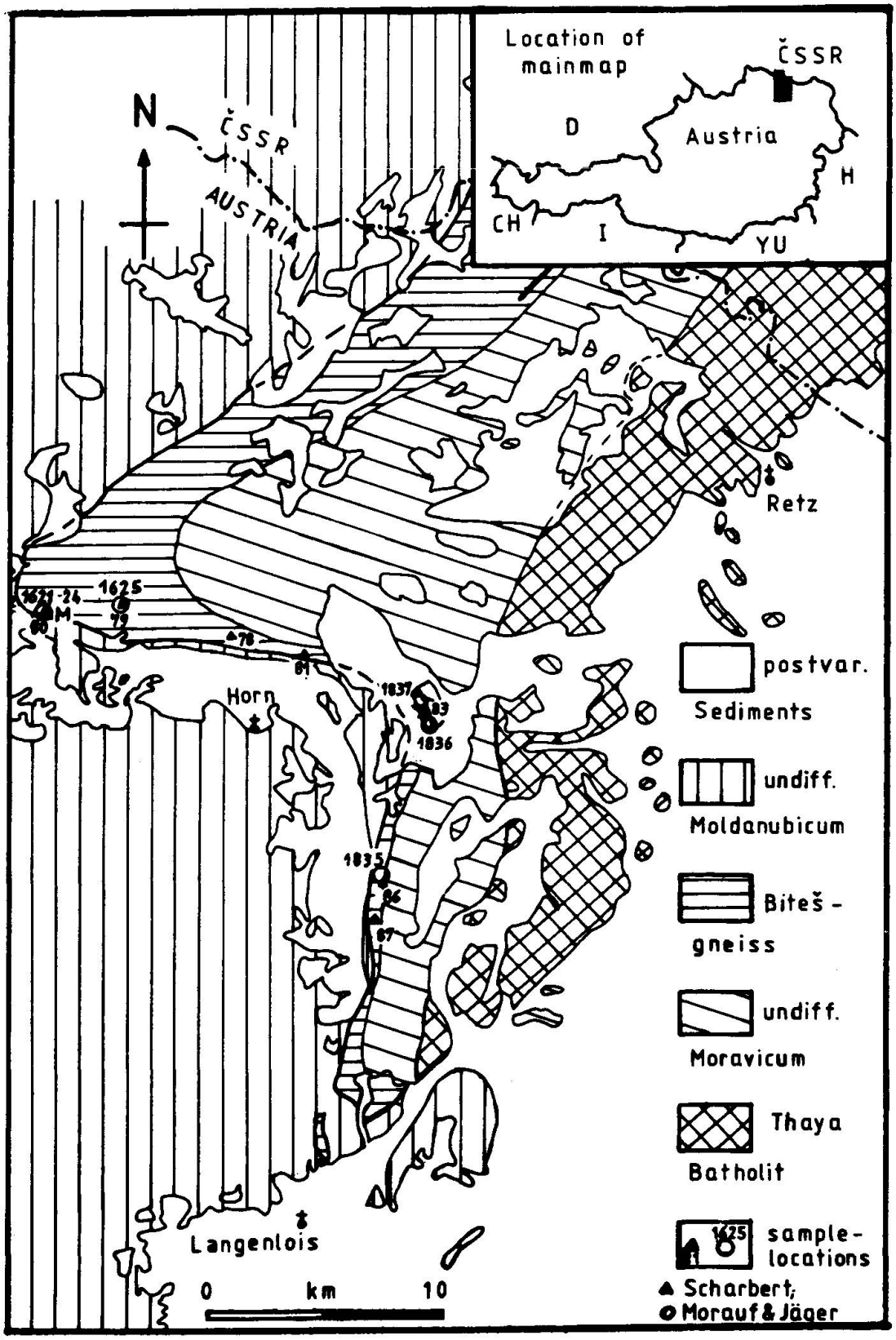

Fig. 1 Map of the sample area, simplified after MATURA (1977). M = quarry S of Messern (comp. text). Two digit numbers are samples from SCHARBERT (1977), four digit numbers are this work (KAW numbers).

METHODS AND RESULTS

Methods

The eight samples of 30 kg were crushed and representative aliquots were ground in an agate mortar mill (WÜTHRICH, 1965) and processed according to JÄGER et al. (1969). In addition from one sample of the Biteš-gneiss both micas were separated (KAW 1625) and purified. The Rb-Sr isotope-ratio measurements were made using a triple filament AVCO-massspectrometer (BRUNNER, 1973). Rb-Sr ages were calculated with the constants recommended by STEIGER & JÄGER (1977). The isochron was calculated after BROOKS et al. (1972).

Results

The results for the Biteš-gneiss and the intercalated samples from the quarry M (see Fig. 1) are plotted on different diagrams (Fig. 2, 3).

In the Sr-evolution-diagram for the Biteš-gneiss (see Fig. 2) three of the four points define a straight line with an age corresponding to 570 ± 44 Ma and an initial $^{87}Sr/^{86}Sr$-ratio of 0,7172 ± 7. This age is interpreted as the formation-age of the Biteš-gneiss.

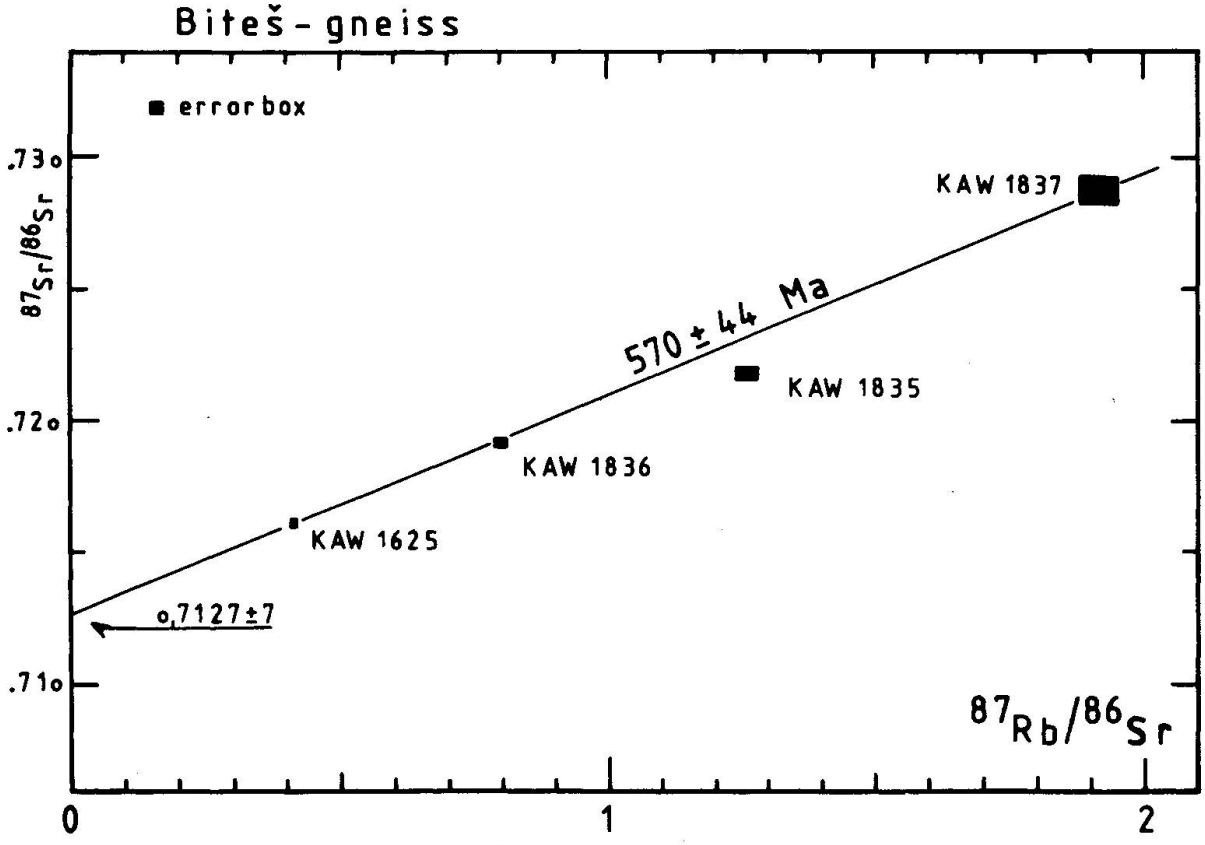

Fig. 2 Sr-evolution-diagram for the Biteš-gneiss, KAW 1835 is not used for the calculation of the isochron.

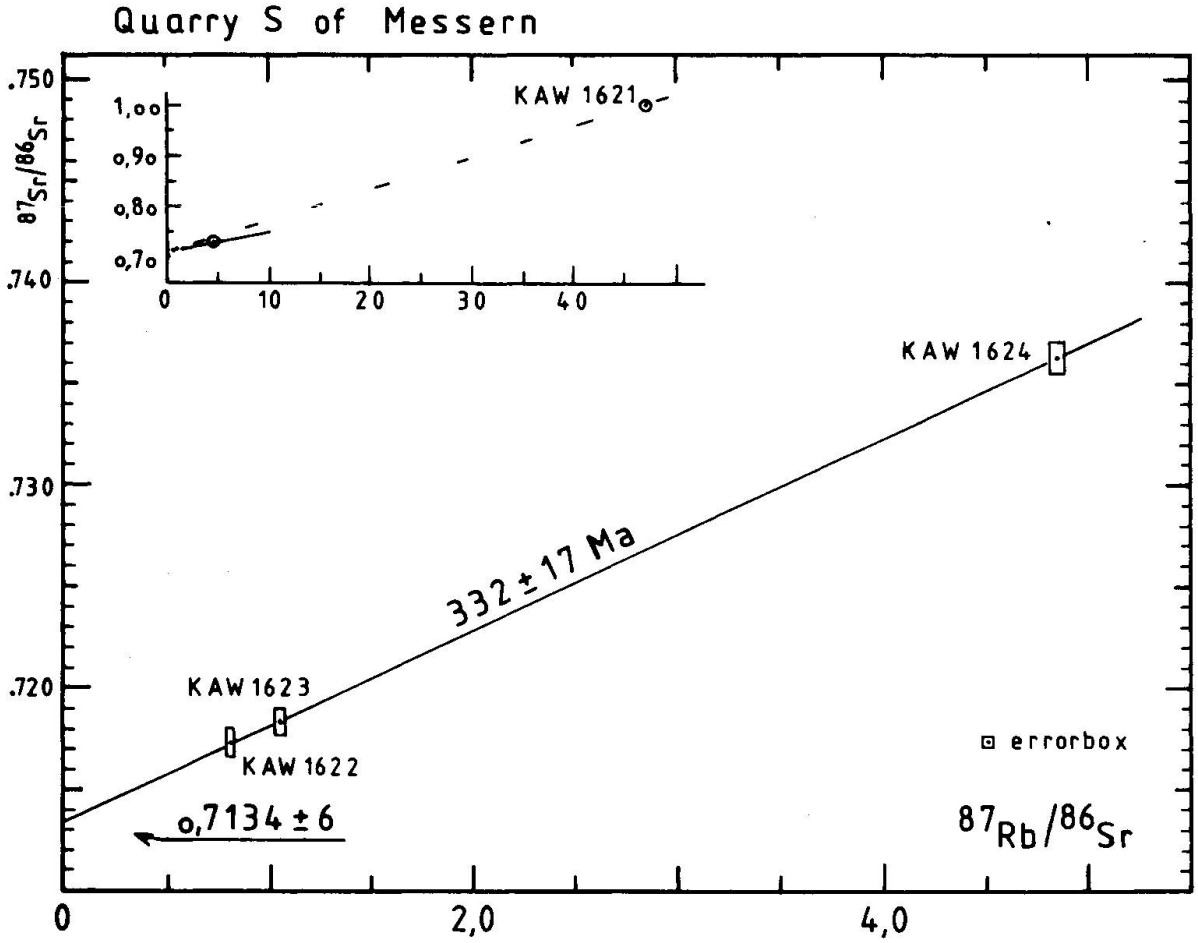

Fig. 3 Sr-evolution-diagram of the rocks from the quarry S of Messern. KAW 1621 is K-feldspar rich and mica poor and therefore not completely reset during the Variscan event.

The two micas, separated from the Biteš-gneiss sample KAW 1625, give ages of 325 ± 7 for the biotite and 326 ± 7 Ma for the muscovite. These ages are regarded as cooling-ages, indicating that the Variscan metamorphic event was sufficient to reset the micas, but was not able to disturbe the whole rock system.

For the samples from the quarry M the results are plotted in Fig. 3. The three mica rich samples define an isochron giving an age of 332 ± 17 Ma with an initial $^{87}Sr/^{86}Sr$-ratio of 0.7134 ± 6. The observation, that the K-feldspar rich sample does not lie on the isochron, reiterates the often observed findings, that mica-rich rocks in tectonic settings are more rapidly reset than mica poor ones.

The Variscan age of the isochron (332 ± 17 Ma) is interpreted therefore as the reset whole rock resulting from the tectonic movements during Variscan times. This value is in good accordance with the Rb-Sr cooling-ages for the micas from the Biteš-gneiss (detailed above, Tab. 3).

COMPARISON: THE BITEŠ-GNEISS WITH THE PLATTENGNEISS

As the comparison of some data on the Biteš-gneiss and the Plattengneiss (Tab. 1) shows, external similarities (tectonised, direction of strike) are not enough. All the data point to two completely different developments.

Table 1 Comparison of some facts from the Biteš-gneiss and the Plattengneiss.

	Biteš-gneiss	Plattengneiss
spread for. $^{87}Rb/^{86}Sr$	0.4 - 1.9	2.3 - 4.0
whole rock isochron	570 ± 44 Ma	135 ± 101 Ma
$^{87}Sr/^{86}Sr$ initial	0.7127 ± 7	0.7200 ± 45
mica ages: muscovite	Rb/Sr 326 ± 7 Ma	Rb/Sr 115 ± 16 Ma
	- - - - - - - - - - -	K/Ar 83 ± 3 Ma
biotite	Rb/Sr 325 ± 7 Ma	Rb/Sr 84 ± 4 Ma
	- - - - - - - - - - -	K/Ar109 ± 3 Ma
time of deformation (strongest visible today)	before 332± 17 Ma, (samples from quarry S of Messern)	before ca. 80 Ma

Data used for the Plattengneis after MORAUF (1982).

COMPARISON WITH PREVIOUS AGE DETERMINATIONS

SCHARBERT (1977) has published an independent study with Rb-Sr-data for the Biteš-gneiss, with some samples collected from approximately the same localities as those in our study. Her data give a fife-point whole rock isochron of 796 ± 49 Ma and an initial $^{87}Sr/^{86}Sr$-ratio of 0.70892 ± 52, at variance with the results of this work: 570 ± 44 and 0.7172 ± 7 for the initial $^{87}Sr/^{86}Sr$-ratio.

Comparing our results with hers (see Tab. 2) we find, that within the limit of error the ratios for $^{87}Sr/^{86}Sr$-ratio are identical for samples from the same small outcrop (1 in Tab. 2). The samples compared under 2 (Tab. 2) are taken from within a maximal distance of 100 m, those shown under 3 (Tab. 2) are from quarries having the same name, but the faces are up to one km apart. The increasing differences in the $^{87}Sr/^{86}Sr$-ratios from 1 to 3 (Tab. 2) show the increasing inhomogeneity with distance. The big differences in the concentrations for Rb und Sr, even within short distance in the Biteš-gneiss (1 in Tab. 2) are so far unaccounted for. Previously, it was thought that the different methods used for the determination of the concentrations could be the reason, but the values given in SCHARBERT (1977) have been checked with Isotope-dilution-technique and yielded the same values within the limits of error (pers. comm. SCHARBERT, February 1982).

These findings emphasize the need for small scale investigations in order to be able to perform large-scale investigations with reliable results. As the differ-

Table 2 Comparison of the isotope-results for three samples from nearly identical sites from the Biteš-gneiss.

	sample Nr. *	Rb ppm	Sr ppm	$^{87}Rb/^{86}Sr$ **	$^{87}Sr/^{86}Sr$	method ***	remarks
1	KAW 1625	93.30	648.8	0.4115	0.7161 ± 4	ID	only one small
	AB 79	100.30	485.0	0.59939	0.71613± 4	X-RF	quarry,ca 50 m wide.
2	KAW 1835	136.80	305.2	1.274	0.7218 ± 6	ID	three small quarries
	AB 86	128.00	340.0	1.0936	0.72124±10	X-RF	within ca 100 m.
3	KAW 1837	150.50	221.4	1.933	0.7284 ± 6	ID	same name for three
	AB 83	144.00	318.0	1.3156	0.72381± 2	X-RF	quarries one km apart.

* KAW numbers are from this work- AB numbers are from Scharbert (1977)

** error estimates are 2% for KAW- and 1% for AB-samples

*** method used for determination of the concentration: ID = isotope dilution
X-RF = X-ray fluorescence

ence of 226 Ma for two isochrones from the same rock indicate, we will have to do a lot more detailed studies to avoid confusion among the scientists relying on age determinations for their interpretations.

Acknowledgements

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Table 3 Rb-Sr-results (isotope dilution) of the Biteš-gneiss.

Sample number KAW	Whole rock or mica type	87 Rb ppm	87 Sr rad.§ ppm	% rad.	comm.& Sr ppm	87Sr/86Sr ± 0.3 %	87Rb/86Sr ± 2.0 %	age,error in Ma	age of isochrone , or corr.'' mica age
1621	whole rock	70.84	0.4694	30.59	15.34	1.023	47.22	465 ± 26	-----
1622	whole rock	29.96	0.2664	0.993	382.3	0.7173	0.8013	-----	332 ± 17
1623	whole rock	32.17	0.2523	1.14	314.9	0.7183	1.045	-----	332 ± 17
1624	whole rock	48.35	0.2612	3.55	102.3	0.7363	4.833	-----	332 ± 17
1625	whole rock	26.11	0.3773	0.83	648.8	0.7161	0.4115	-----	570 ± 44
1625	biotite	216.4	1.004	68.09	6.77	2.226	326.8	326 ± 13	325 ± 7
1625	muscovite	111.2	0.5298	14.93	43.45	0.8348	26.003	336 ± 42	326 ± 7
1835	whole rock	38.03	0.3494	1.62	305.2	0.7218	1.274	-----	
1836	whole rock	31.50	0.3483	1.24	399.4	0.7191	0.8065	-----	570 ± 44
1837	whole rock	41.85	0.3965	2.51	221.4	0.7284	1.914	-----	570 ± 44

§ rad. = radiogenic; & comm. = common ; '' corr. = corrected with the whole rock 87Sr/86Sr-ratio.

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Appendix

Sample localities and description

The following statements are valid for all samples: If not otherwise stated then the diameter of the augen is around 3 mm. The augen are inhomogenous feldspar-augen, showing tectonisation of different degrees.

The rock shows a thin layering, but gives still rise to thicker splitting, and is normally fine grained.

Quarry S of Messern (M on the map, Fig. 1) 15°31′42″/48°42′41″

KAW 1621 A reddish grey, massive looking rock showing rarely lineation and having occasionally augen. The reddish colour denotes the more abundant feldspar.

KAW 1622 A dark grey rock, where on the cleavage plane white mica- and equal abundant biotite-crystals are stretched in the direction of the lineation. The infrequent augen vary widely in size up to a maximum of 8 mm diameter.

KAW 1623 A grey medium grained rock showing-besides continuouse white mica layers-cleavage-surfaces with only occasionally white micas and rare biotite clearly outlining the lineation.

KAW 1624 A dark grey rock, with flat and wavy s-planes, having continuouse layer of biotite, which is aligned in the lineation. Augen and white micas are rare.

Biteš-gneiss samples

KAW 1625 Fuchsbergergraben 15°34′04″/48°42′52″
A bluish grey rock, which breaks thickly and shows only occasionally augen in a medium grained matrix. White micas and biotite trend to make a closed texture and are evenly and equally distributed, stretched in the lineation.

KAW 1835 Mörtersdorfer Kehre 15°43′42″/48°36′24″
This light rock shows on different cleavage-planes differently developed lineations: From hardly visible to strong developed, always are the micas (white mica more abundant than biotite) stretched in the direction of the lineation.

KAW 1836 S of Kleinmeiseldorf 15°43′58″/48°39′19″
The often big augen (up to 1 cm) are abundant in this rock, which looks light grey and massive. White micas and biotite together giving nearly closed layers, in which the lineation is clearly visible.

KAW 1837 N of Kleinmeiseldorf 15°43′42″/48°40′19″
This light, whitish rock show cleavage planes where the abundant augen (up to 1 cm diameter) cause the plane to become wavy. On the surface the white micas (finegrained) are visibly stretched denoting the lineation. Sometimes white micas (ca. 5 mm diameter) occur on the surface, where also biotite concentrations are found.