MOLDAVITES FROM LUSATIA (GERMANY) III: Sr-ISOTOPE-, $^{40}Ar/^{39}Ar$-, AND FISSION TRACK-STUDIES

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Abstract: $^{87}Sr/^{86}Sr$-, $^{40}Ar/^{39}Ar$-, and fission track-analyses are presented for tektites from Lusatia. Both, $^{87}Sr/^{86}Sr$- and $^{40}Ar/^{39}Ar$-analyses, confirm without any ambiguity that these tektites belong to the moldavite strewn field. Fission track dating, on the other hand, yield thermally lowered ages for the Lusatian moldavites. The data for these tektites indicate a complete loss of their fossil fission track record 0.9 - 2.3 Ma after tektite formation and probably is related to the redeposition history of the Lusatian moldavites.

Samples and Methods: Two moldavites from the Ottendorf-Okrilla and Brauna sites in Lusatia were analysed by the $^{87}Sr/^{86}Sr$- and fission track-methods. In addition, we also determined the $^{40}Ar/^{39}Ar$-age of the Ottendorf-Okrilla moldavite.

Results: Accounts on the Rb- and Sr-systematics of Czech moldavites are presented in [1-4]. These systematics provide the basis to study the relationship of the Lusatian moldavites to the other moldavites sub-strewn fields and to the Ries Crater. Our $^{87}Sr/^{86}Sr$-data show that the Lusatian moldavites are related to the other moldavite sub-strewn fields (Fig. 1). A detailed comparison with the data from [1] indicates $^{87}Sr/^{86}Sr$ for the two Lusatian and the one Moravian moldavites slightly higher than the ratios for the Bohemian samples. The significance of the conformity of $^{87}Sr/^{86}Sr$ in Lusatian tektites with the value in the only studied Moravian moldavite tektite is questionable.

The moldavite from Ottendorf-Okrilla, sample ML-OTT18, was dated by $^{40}Ar/^{39}Ar$ and we obtained a plateau age of 14.40 ± 0.25 Ma (Fig. 2) and an indistingiushable isochrone age of 14.41 ± 0.06 Ma with $(^{40}Ar/^{36}Ar)_0$= 263 ± 21. This age corresponds within error limits to the generally accepted age of Czech moldavites (15.1 ± 0.7 Ma [5, 6]). In a previous study of a Czech moldavite we obtained a $^{40}Ar/^{39}Ar$ plateau age of 15.21 ± 0.25 Ma [7]. If the age difference is taken serious, it could results from heating the Lusatian moldavite 10 Ma ago e.g. in a short pulse (725°C for 10 days) or during a prolonged period at elevated temperatures (300°C for 2 Ma).

Fission track dating of the two Lusatian moldavites (ML-BRN1, ML-OTT18) yields apparent ages of 10.7 Ma and 11.9 Ma, sensibly lower than the fission track age of 14.9 Ma for a Bohemian moldavite analysed in the same dating set (Tab. 2). Size analyses [8] of fossil and induced fission tracks prove that the fission track ages of the two Lusatian samples are thermally lowered by a slight recent thermal event. Their corrected fission track ages of 12.6 Ma and 14.0 Ma are still sensibly lower than the age of the Bohemian sample. This finding suggests a quantitative reset of the fission track clock at 2.3 Ma resp. 0.9 Ma after the formation of these two tektites. Following [9] this reset could be caused by thermal effects like long-termed exposure to the sun or grass- or brush fires. In this case the corrected ages would correspond to the time of redeposition of the Lusatian moldavites. This interpretation is endorsed by geologic and stratigraphic studies [10] which indicate a sedimentation age for the Lusatian moldavites of Upper Miocene to Lower Pliocene.

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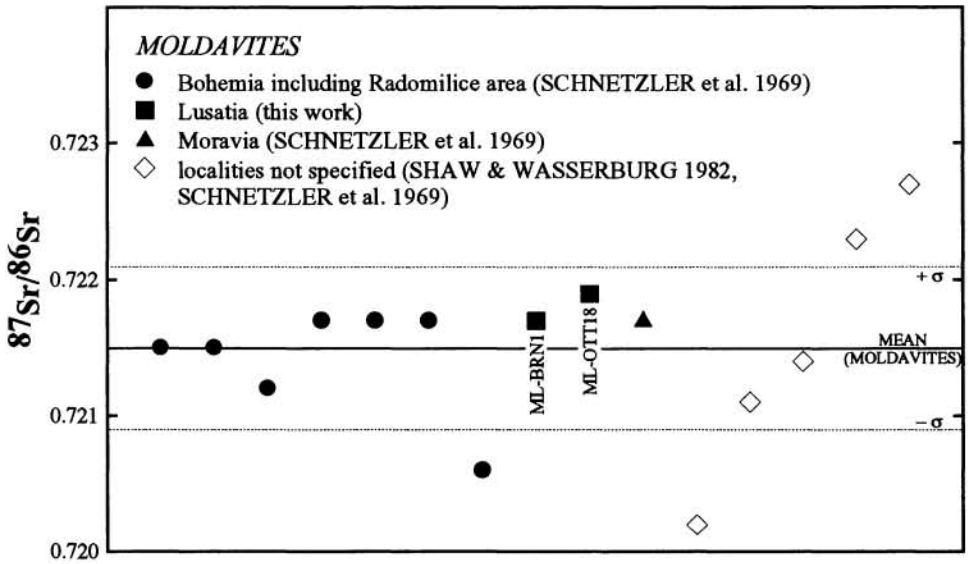

Fig. 1. $^{87}Sr/^{86}Sr$ of moldavites from various sub-strewn fields calculated for t = -15Ma

Table 1. Rb- and Sr-concentrations and $^{87}Sr/^{86}Sr$ of two Lusatian moldavites

sample	Rb [1]	Sr [2]	$^{87}Sr/^{86}Sr$ [3]	$^{87}Sr/^{86}Sr$ [4]
	$\bar{x} \pm s_x$	$\bar{x} \pm s_x$		
ML-BRN1	154 ± 2	129 ± 0.1	0.72241 ± 4	0.7217
ML-OTT18	157 ± 2	120 ± 0.1	0.72274 ± 5	0.7219

1) flame photometric analysis
2) isotope dilution
3) thermal ion mass spectrometry
4) calculated for t = -15 Ma

Table 2. Fission track ages of Lusatian and Bohemian moldavites

sample	apparent age [Ma] [1]	track size reduction	track density reduction	corrected age [Ma]
	t_m	l/l_0	p/p_0	t_{corr}
ML-BRN1	10.71 ± 0.20	0.95	0.85	12.59 ± 0.23
ML-OTT18	11.89 ± 0.21	0.95	0.85	13.99 ± 0.24
Bohem. mold.	14.86 ± 0.19	1.00	1.00	14.86 ± 0.19

The error is the standard deviation of counting statistics
1) $\lambda_f = 8.46 \cdot 10^{-17}\ a^{-1}$

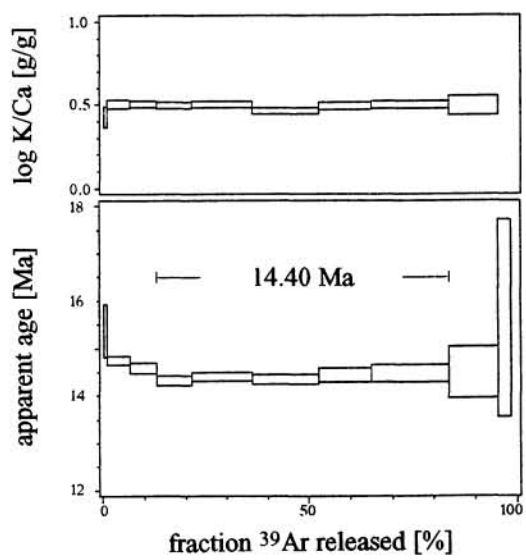

Fig. 2. K/Ca and age spectra of Lusatian moldavite ML-OTT18