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The $^{40}Ar/^{39}Ar$ cooling ages of white micas from the Jegłowa Beds (Strzelin Massif, Fore-Sudetic Block, SW Poland)

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Abstract The metamorphic rocks of the Strzelin Massif, in the Fore-Sudetic Block, underwent polyphase tectonothermal evolution terminating with late orogenic gravitational collapse. These rocks recorded Early Permian cooling ages in the range of 279–285 Ma, obtained on white mica concentrates derived from metasediments of the Jegłowa Beds. The obtained results correspond to the youngest group of ages presented by Maluski *et al.* (1995) from the northern part of the Jeseník Mts, the Moravo-Silesian Zone of the East Sudetes. They suggest very low exhumation rate.

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INTRODUCTION

The Strzelin Massif emerges from beneath Cenozoic sediments in the northern Sudetic foreland, ca 40 km south of Wrocław. It forms an isolated outcrop of Variscan basement exposed directly north of a mountainous area of the East Sudetes. The ages of deformation and cooling of the crystalline complexes contained in the East Sudetic domain were already documented by Maluski *et al.* (1995). However, as yet no radiometric data on the timing of the metamorphism and subsequent cooling are available for the Strzelin Massif itself.

The purpose of this study was to investigate and describe the thermal history of the Strzelin Massif (Fig. 1), using $^{40}Ar/^{39}Ar$ data for white micas derived from the Jegłowa Beds. The beds mainly comprise quartzites which are believed to be of Devonian age and to represent an equivalent to those from the Vrbno Group of the Czech East Sudetes. The obtained results indicate surprisingly young cooling ages for the studied rocks, and suggest that the Strzelin Massif underwent very slow exhumation after the final stages of deformation and regional metamorphism.

GEOLOGICAL SETTING

The East Sudetes form part of a collision-related belt of deformation and metamorphism, nearly 50 km wide and 300 km long, which occupies the eastern margin of the Bohemian Massif. The belt is composed of nappe piles that crop out from below the upper plate of the collision zone, represented in its northern part by Central Sudetic rock complexes. The east Sudetic pile of nappes consist of medium-grade metamorphosed Neoproterozoic Cadomian crust, partly Variscan reworked, involved in nappe tectonics and folded together with its metamorphic Devonian and Lower Carboniferous cover (e.g. Misař, 1995). It is overridden from the west by the Orlica–Śnieżnik Massif and the Staré Město Belt, and exposed in a tectonic half-window. The East Sudetic nappes are referred to as the Silesian units (Suess, 1912; 1926; Dudek, 1980), and usually described as a part of the larger Moravo-Silesian Zone (e.g. Franke & Żelaźniewicz, 2000), which includes, besides metamorphic complexes, an extensive Devonian–Carboniferous sedimentary basin situated more to the east.

The East Sudetic domain is usually expected to continue northward below the cover of Cenozoic sediments (e.g. Grocholski, 1976). Accordingly, the Strzelin Massif is often thought to represent an isolated outcrop of mostly concealed East Sudetic basement (e.g. Bederke, 1929; Grocholski, 1975; Skácel, 1989). However, alternative interpretations have also been presented, assuming a West Sudetic affinity for the Strzelin Massif (Oberc, 1966;

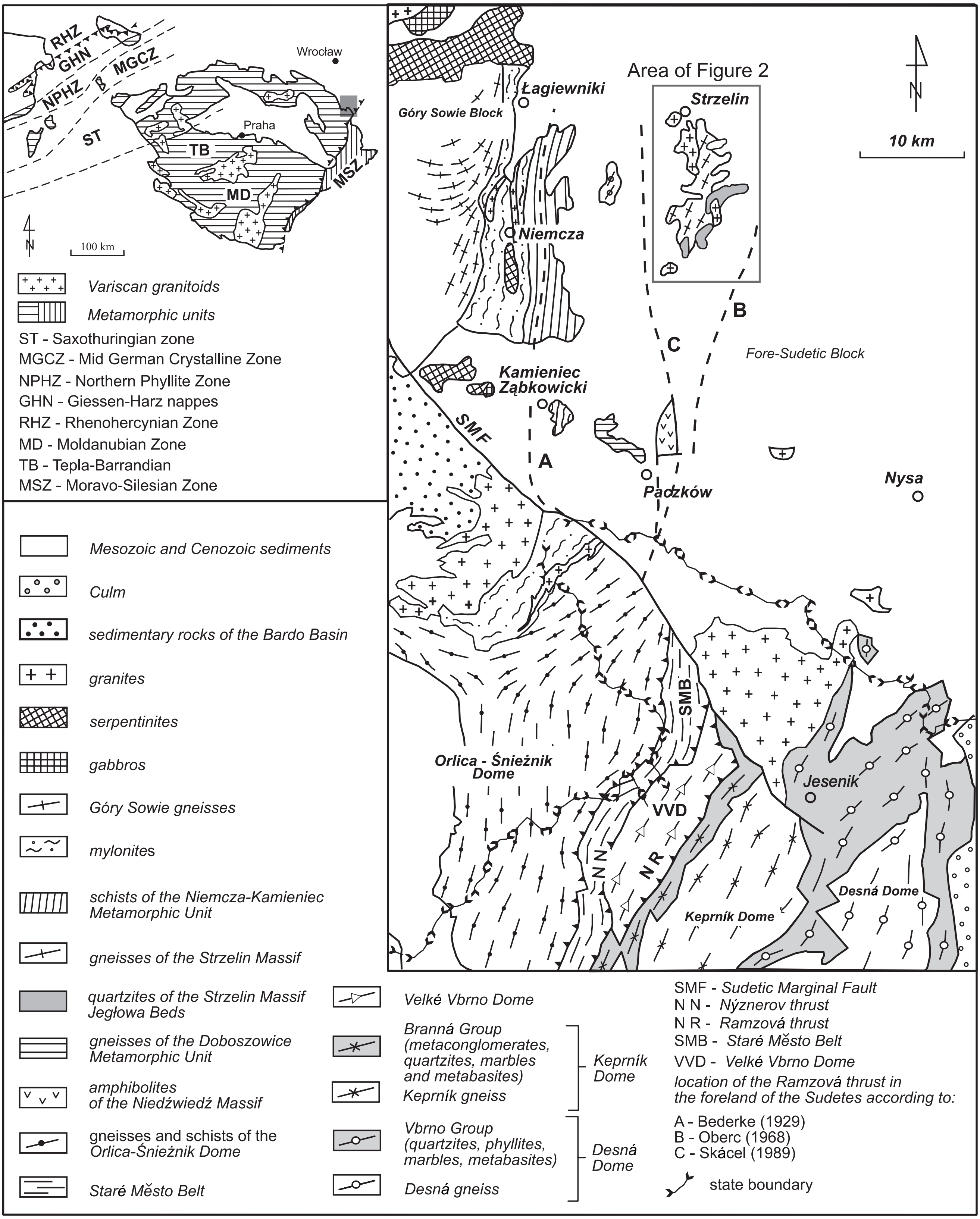

Fig. 1. Regional setting of the study area; the inset shows location of the study area on the sketch map of the Bohemian Massif after Puziewicz *et al.* (1999), slightly modified.

Oliver *et al.*, 1993; Cymerman *et al.*, 1997) or its tectonic setting on both sides of the East/West Sudetes contact zone (Franke & Żelaźniewicz, 2000; Oberc-Dziedzic, 2001). The inferred equivalence of the Strzelin Massif and the East Sudetic domain is mostly based on an apparent similarity of their lithological units. The Strzelin quartzite succession, although not yet paleontologically dated, closely corresponds to the Early/Middle Devonian quartzites of the Vrbno group in the Czech part of the east Sudetes (Bederke, 1931; Chlupač, 1989). At the same time, East Sudetic affinities for at least some of the Strzelin orthogneisses are documented by their Late Proterozoic U-Pb SHRIMP ages (Oberc-Dziedzic *et al.*, 2000). Furthermore, the structural record of the Strzelin Massif, with syn-collisional thrusting to the E or NE and subsequent bi-vergent NE-and SW-directed extensional collapse (Szczepański, 2001), is analogous to that known from the mountainous part of the East Sudetes (Cháb *et al.*, 1994; Schulmann & Gayer, 2000) and adjacent areas of Sudetic Foreland (Mazur & Józefiak, 1999).

$^{40}Ar/^{39}Ar$ dating of the East Sudetic rock complexes exposed in the Jeseník Mts yielded five groups of ages related to consecutive tectonothermal events (Maluski *et al.*, 1995). The oldest one was ascribed to a wide time span of 340–440 Ma. It was followed by younger events successively dated at: 320–340 Ma, 300–310 Ma and 279–290 Ma. The thermal evolution of the area was terminated by the 270–90 Ma episode (Maluski *et al.*, 1995). All the described thermal events were attributed by Maluski *et al.* (1995) to subsequent stages of metamorphism and deformation.

The Strzelin Massif (Fig. 2) comprises four distinct rock complexes. These are: (1) orthogneisses, (2) a schist series, (3) the Jegłowa Beds and (4) Variscan granitoids. The orthogneisses occur in two main varieties: the Strzelin gneiss in the north and the Nowolesie gneiss in the south of the studied area. U-Pb SHRIMP zircon dating of the Strzelin orthogneisses yielded values of 568–600 Ma, interpreted as the protolith age (Oberc-Dziedzic *et al.*, 2000). The locally exposed supracrustal schist series is composed of mica schists, paragneisses, calc-silicate rocks and amphibolites. The schist complex, which originally must have been the supracrustal envelope intruded by the protolith of gneisses, is believed to be of Neoproterozoic age (Oberc, 1966). Several thrust sheets of Devonian quar- tzites, the so called Jegłowa Beds, are tectonically interleaved with the orthogneiss and schist complexes. The protolith of the Jegłowa Beds probably consist of quartz sandstones with minor intercalations of arkosic and lithic varieties (Patočka & Szczepański, 1997). The metamorphic rocks of the Strzelin Massif are intruded by Variscan granitoids, dated at 330±6 and 347±12 Ma using the Rb-Sr whole rock method (Oberc-Dziedzic *et al.*, 1996).

The Jegłowa Beds recorded three metamorphic episodes (Szczepański, 1999; Szczepański & Józefiak, 1999) correlated with three deformation events (Szczepański, 2001). The conditions of the M_1 episode were established as corresponding to the greenschist facies (T = 500°C and p = 6 kbar). It was presumably related to the E or NE-vergent nappe transport initiated in response to the Variscan collision. The second metamorphic event M_2 involved a change in the PT conditions, with values decreasing from maximum of 6 kbar and 500°C. Simultaneously, the Jegłowa Beds underwent progressive folding. During the M_3 event the rocks experienced HT/LP metamorphism (~3.8 kbar and ~630°C) associated with late orogenic gravitational collapse. The high geothermal gradient during the M_3 event (~45°C/km) was most probably related to numerous late orogenic granitoid intrusions. Moreover, the granites, cutting the metamorphic rocks discordantly, exhibit a magnetic fabric parallel to deformation structures originated during the D_3 episode (Szczepański *et al.*, 2000). Consequently, emplacement of the granites was probably related to a late phase of the D_3 event.

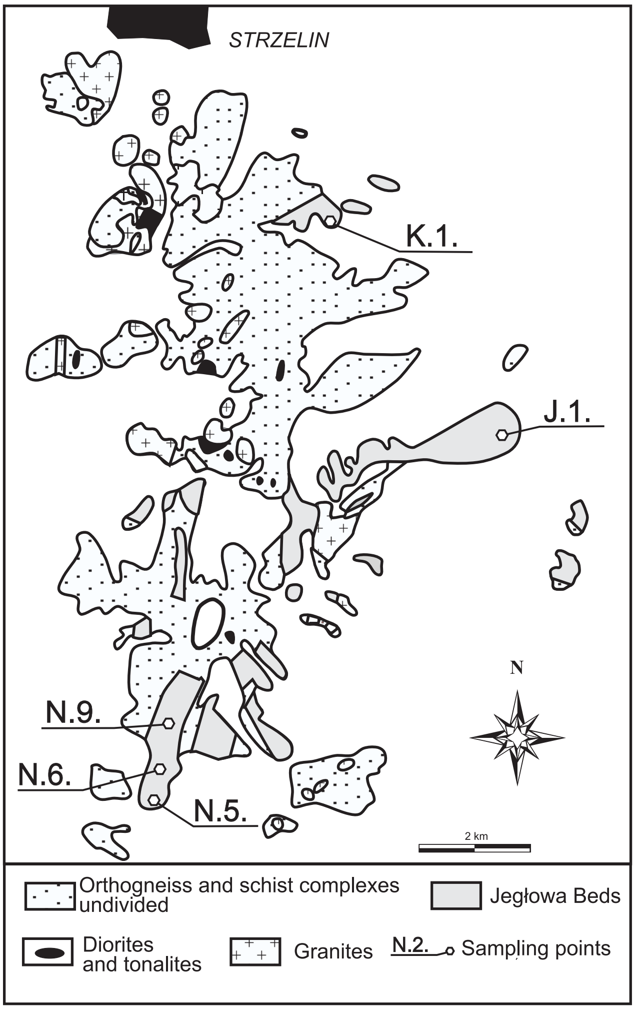

Fig. 2. Geological sketch map of the Strzelin Massif after Oberc *et al.* (1988).

During the Late Carboniferous, the Strzelin Massif must have been exposed at the surface since it supplied clastic material to the Laskowice graben (Kiersnowski, 1983; 1995). The graben, situated on the north-eastern periphery of the Strzelin Massif, was initiated during the latest Carboniferous (Kiersnowski, 1983; 1995).

METHODS OF INVESTIGATION AND SAMPLING

Five white mica concentrates were selected for the isotopic study (Fig. 2). 30 mg concentrates were irradiated using fast neutrons (~10^{12} neutrons/cm^2) in the nuclear reactor of the Laboratory of Nuclear Energy in Świerk. An assessment of Ar isotopes within the investigated samples was performed using a modified mass spectrometer MS-10, in the Institute of Physics of the Marie Curie-Skłodowska University in Lublin. The results of the isotopic investigations are shown in Tab. 1. The concentrates were examined using the stepwise heating method (Merrihue & Turner, 1966) at the max. of 10 determination steps (apart from sample K1) and 100°C increments of temperature.

A thin section examination of each of samples collected for geochronological analysis was carried out as the preliminary step. It was possible to reject those which were too fine-grained, contained mineral inclusions or showed alteration effects. Furthermore, the selected samples contained only one generation of white mica, expected to have recorded only one particular tectonometamorphic event. The samples taken from the northern part of the massif (J1 and K1) only contained the generation of white mica developed during the M_2 episode. On the other hand, the samples collected in the southern part of the massif (N5, N6 and N9) almost exclusively had micas which crystallised during the M_3 episode. Nevertheless, removal of small admixtures of white micas that had originated during other metamorphic events was not entirely possible. The samples were crushed and sieved to a 0.5–0.125 mm size fraction and the white micas were separated using the standard magnetic technique. The final purification of the concentrates was achieved by hand picking.

ISOTOPIC DATA

The results are discussed collectively for the whole Strzelin Massif. The apparent ages are presented as classical age spectra (Fig. 3), where the age is plotted against the cumulative ^{39}Ar isotope released during each increment of temperature. Inversed correlation diagrams were also used (Fig. 3). 100°C Increments of temperature were applied during the analyses, starting from 450°C (or 500°C in the case of sample K1) and finishing at 1350°C (or 1300°C in the case of sample K1).

All the obtained age spectra are very regular, displaying a well-developed plateau. The first two temperature increments (and for samples N6 and N9, also the third increment) show younger ages than those for the remaining part of the released portion of ^{39}Ar. It does not exceed the first 10% (20% in the case of samples N6 and N9) of the released ^{39}Ar. In fact, this first portion of ^{39}Ar released in the low temperature range (500–700°C) corresponds to ages of 193–226 Ma. The remaining part of the released ^{39}Ar define a plateau which is interpreted as the closure time of the isotopic system. The obtained ages are between

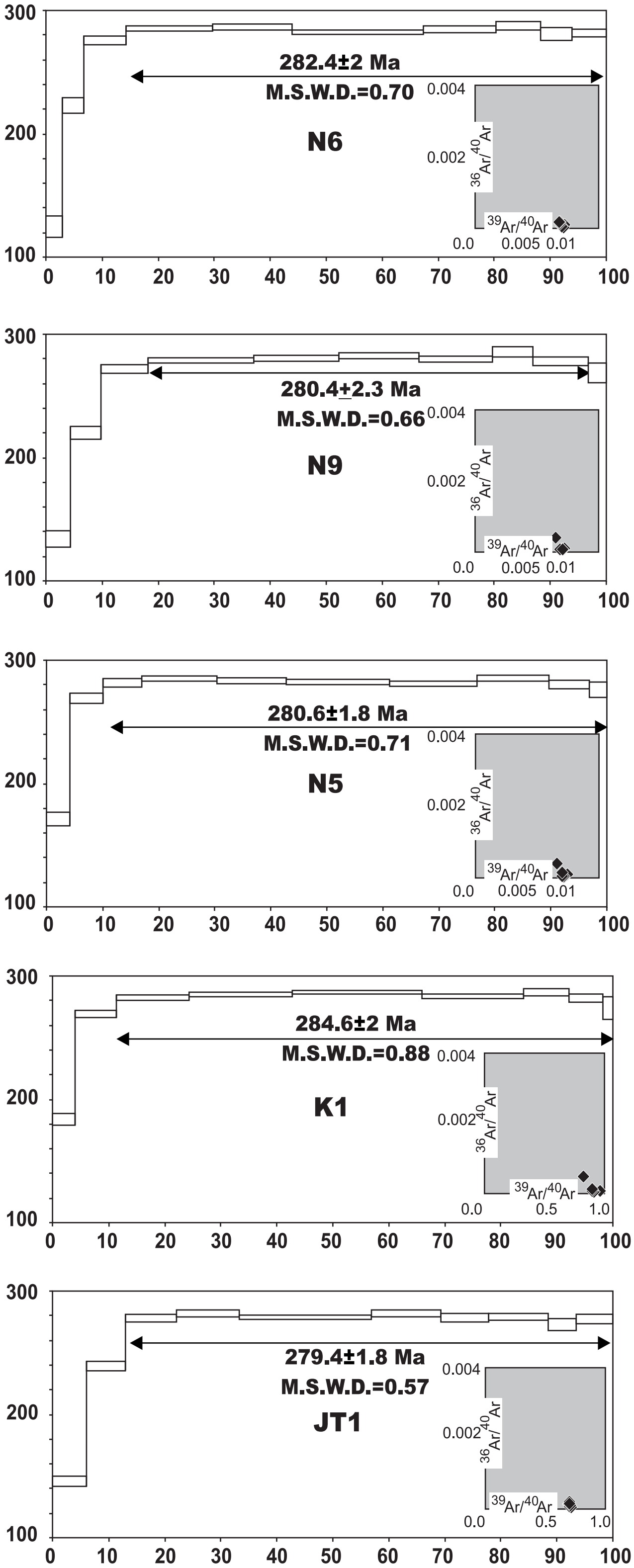

Fig. 3. Age spectra of the analysed white mica concentrates. Reversed isochron diagrams corresponding to the particular white mica concentrate are shown to the left of each age spectrum.

279–285 Ma. Moreover, a very well-defined plateau (MSDW is in the range between 0.57–0.88) suggests quite a simple thermal history for the analysed samples.

In order to determine the composition of the initial

Table 1

A summary of the isotopic analysis results

Sample K1	T [°C]	%^{39}Ar	%$^{40}Ar^*$	Age [Ma]	Sigma [Ma]	$^{36}Ar/^{39}Ar$	$^{40}Ar/^{39}Ar$
1	500	4.0	82.6	183.8	4.5	0.04199	71.1911
2	600	7.3	97.8	269.2	2.8	0.00664	90.1285
3	700	13.0	98.0	282.6	2.1	0.00660	94.8864
4	800	18.4	98.5	284.8	1.9	0.00500	95.1751
5	900	23.2	98.8	286.8	1.8	0.00379	95.5532
6	1000	18.1	98.3	283.6	1.9	0.00551	94.9256
7	1100	8.2	97.4	286.9	2.7	0.00840	96.9510
8	1200	6.0	96.1	282.1	3.3	0.01286	96.5595
9	1300	1.8	85.4	274.0	9.4	0.05194	105.2234
Sample JT1							
1	450	6.1	83.8	146.6	4.1	0.03041	55.3521
2	550	6.8	94.1	239.4	3.8	0.01640	82.6032
3	650	9.2	95.2	277.9	3.1	0.01542	95.8092
4	750	11.2	96.6	281.9	2.7	0.01113	95.9528
5	850	23.6	98.2	279.0	1.9	0.00574	93.3431
6	950	12.3	97.6	281.9	2.6	0.00767	94.9477
7	1050	8.6	96.2	278.5	3.2	0.01224	95.0724
8	1150	10.6	97.0	279.5	2.8	0.00962	94.6405
9	1250	4.9	93.9	273.0	5.0	0.01961	95.3015
10	1350	6.7	95.7	277.7	3.9	0.01406	95.3173
Sample N9							
1	450	4.4	69.8	134.7	6.4	0.06221	60.8599
2	550	5.4	89.3	220.5	5.3	0.02878	79.7287
3	650	8.5	96.4	271.8	3.6	0.01143	92.4761
4	750	18.7	97.7	278.8	2.2	0.00724	93.6888
5	850	15.2	97.4	280.6	2.5	0.00832	94.6545
6	950	14.3	97.9	282.3	2.5	0.00676	94.8036
7	1050	13.1	97.7	279.7	2.7	0.00738	94.0716
8	1150	7.1	97.4	285.6	4.2	0.00849	96.5113
9	1250	9.9	97.3	278.0	3.2	0.00858	93.8232
10	1350	3.4	86.2	268.4	8.0	0.04782	102.0302
Sample N6							
1	450	2.9	65.7	124.3	8.5	0.06911	59.5070
2	550	3.8	94.9	221.4	6.2	0.01294	75.3515
3	650	7.6	97.2	273.8	3.5	0.00871	92.3879
4	750	15.3	98.7	283.4	2.3	0.00431	94.4847
5	850	14.1	98.5	284.7	2.4	0.00470	95.0551
6	950	23.4	99.1	280.4	1.9	0.00282	92.9547
7	1050	13.0	98.2	282.8	2.5	0.00574	94.6821
8	1150	7.8	96.7	285.5	3.4	0.01102	97.2156
9	1250	5.7	94.5	278.2	4.4	0.01798	96.6617
10	1350	6.4	94.6	280.5	3.9	0.01788	97.4492
Sample N5							
1	450	4.3	82.4	170.5	5.2	0.03921	65.9107
2	550	5.8	97.4	267.1	4.0	0.00791	89.7608
3	650	6.9	97.5	279.2	3.5	0.00809	94.0927
4	750	13.3	98.9	282.8	2.3	0.00354	94.0314
5	850	12.3	98.9	281.3	2.4	0.00345	93.4739
6	950	18.4	99.1	280.0	2.0	0.00289	92.8451
7	1050	15.6	98.6	278.9	2.2	0.00446	92.9348
8	1150	12.7	98.4	283.4	2.4	0.00524	94.7605
9	1250	7.2	95.9	277.9	3.4	0.01313	95.1435
10	1350	3.5	88.5	274.0	6.2	0.03950	101.5311

Ar, inversed $^{36}Ar/^{40}Ar$–$^{39}Ar/^{40}Ar$ isochron diagrams were used. Taking into account the very low proportion of $^{36}Ar/^{40}Ar$, the projection points of the analysed white mica concentrates are located within the lower part of the diagram. This implies that the Ar enclosed in the white mica plates almost exclusively originated from radiogenic ^{40}K decay. The remaining non-radiogenic component, which in this case is negligible in amount, is probably that derived from the atmosphere.

INTERPRETATION

The obtained isotopic data show two essential features which are: plateau ages very young, less than 284 Ma and a lack of a difference between the plateau ages of white micas collected in different parts of the study area. This implies that the presented results correspond to cooling ages related to the exhumation of the Strzelin Massif, rather than representing a record of any tectonometamorpic event. In the latter case, the results would differ in various parts of the massif, as the investigated rocks preserved micas originated during different tectonometamorphic events. The closing temperatures for the white micas suggested by most workers are in the range of 330–430°C (McDougall & Harrision, 1988). Thus, the obtained cooling ages were associated with a medial phase of the exhumation, when the rocks passed the isotherms of 330 to 430°C. The youngest obtained ages (in the range between 193 to 226 Ma) were calculated based on the first portion of the released ^{39}Ar, and may have resulted from a partial loss of Ar due to a younger thermal episode. It is however more probable that they reflect the influence of small mineral inclusions degassed in the low temperature range of the experiments.

The very young cooling ages presented in this paper correspond to the youngest of those reported by Maluski *et al.* (1995) from the Jeseník Mts. Maluski *et al.* (1995) interpreted these youngest ages as related to the reactivation of the Bela and Ramzova fault zones. These zones would have play a role of channels transporting heat from the Žulová granitoid intrusion. However, this interpretation is not consistent with the age of the Žulová pluton, recently dated at 340 Ma (Jedlička, 1995). Therefore, it seems more likely that the youngest Variscan ages reported in this paper and obtained by Maluski & co-authors (Maluski *et al.* 1995) represent the time of cooling and passing of the massifs through the 330–430°C isotherms.

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REFERENCES

BEDERKE, E., 1929. Die Grenze von Ost- und Westsudeten und ihre Bedeutung für die Einordnung der Sudeten in den Gebirgsbau Mitteleuropas. *Geologische Rundschau*, 20: 186–205.

BEDERKE, E., 1931. Die moldanubische Überschiebung im Sudetenvorlande. *Zentralblatt für Mineralogie, geologie und Paläontologie, Abtailungen B*, 349–408.

CHÁB, J., MIXA, P., VANECEK, M. & ŽÁČEK, V., 1994. Evidence of an extensional tectonics in the NW of the Hrubý Jesenik Mts. (the Bohemian Massif, Central Europe). *Věstník Českého geologického ústavu*, 63: 7–15.

CHLUPAČ, I., 1989. Fossil communities in the metamorphic Lower Devonian of the Hrubý Jeseník Mts., Czechoslovakia. *Neues Jahrbuch für Geologie und Paläontogie, Abhandlungen*, 177: 367–392.

CYMERMAN, Z., PIASECKI, M.A.J. & SESTON, R., 1997. Terranes and terrane boundaries in the Sudetes, northeast Bohemian Massif. *Geological Magazine*, 134: 717–725.

DUDEK, A., 1980. The crystalline basement block of the Outer Carpathians in Moravia: Bruno-Vistulicum. *Rozpravy Československej Akademii Věd, Rada matematicko-přirodovedeckych Věd*, 90, 1–85.

FRANKE, W. & ŻELAŹNIEWICZ, A., 2000. The eastern termination of the Variscides: terrane correlation and kinematic evolution. In: Franke, W., Haak, Q., Oncken, O. & Tanner, D., (Eds.), *Orogenic processes: Quantification and modelling in the Variscan belt of Central Europe, Geological Society, London Special Publications*, 179: 63–86.

GROCHOLSKI, A., 1976. Zagadnienie waryscyjskiej przebudowy NE obrzeżenia Masywu Czeskiego. [On Variscan reconstruction of NE margin of the Bohemian massif]. *Przegląd Geologiczny*, 6: 357–362.

JEDLIČKA, J., 1995. The Žulová massif in Silesia – its geochemistry and petrogenesis. (Unpublished PhD thesis). Charles University, Czech Republic. {In Czech only}.

KIERSNOWSKI, H., 1983. Rozwój sedymentacji utworów klastycznych późnego paleozoiku w okolicach Brzegu. [Development of sedimentation of Upper Paleozoic clastic rocks in the vicinities of Brzeg]., *Przegląd Geologiczny*, 31: 475–479.

KIERSNOWSKI, H., 1995. Origin and development of the Late Paleozoic Eastern Fore-Sudetic Basin. *Proceedings of the 66th meeting of the Polish Geological Society. Special volume*, pp 19–35.

MALUSKI, H., RAJLICH, P. & SOUČEK, J., 1995. Pre-Variscan, Variscan and Early Alpine thermo-tectonic history of the north-eastern Bohemian Massif: An $^{40}Ar/^{39}Ar$ study. *Geologische Rundschau*, 84: 345–358.

MAZUR, S. & JÓZEFIAK, D., 1999. Structural record of Variscan thrusting and subsequent extensional collapse in the mica schists from the vicinities of Kamieniec Ząbkowicki, Sudetic Foreland, SW Poland. *Annales Societatis Geologorum Poloniae*, 69: 1–26.

McDOUGALL, I. & HARRISON, T.M., 1988. Geochronology and thermochronology by the $^{40}Ar/^{39}Ar$ method. Oxford University Press – Oxford, pp. 212.

MERRIHUE, C.M. & TURNER, G., 1966. Potassium-argon dating by activation with fast neutrons. *Journal of Geophysical Research*, 71: 2852–2857.

MISAŘ, Z., 1995. VIII. Moravo-Silesian Zone. C. Allochthonous units. 1. Stratigraphy. In Dallmeyer, R.D., Franke W. & Weber K., (Eds.) *Pre-Permian geology of Central and Eastern Europe*, Springer-Verlag, Berlin Heidelberg, 521–529.

OBERC, J., 1966. Geologia krystaliniku Wzgórz Strzelińskich [Geology of crystalline rocks of the Wzgórza Strzelińskie Hills, Lower Silesia]. *Studia Geologica Polonica*, 20: 9–187.

OBERC, J., OBERC-DZIEDZIC, T. & KLIMAS-AUGUST, K., 1988. Geological map of the Strzelin Massif 1: 25 000. Institute of Geological Sciences of Wrocław University and "PROXIMA" Geological Company.

OBERC-DZIEDZIC, T., 2001. Variscan overthrust of Lower Palaeozoic gneisses on Cadomian basement in the Strzelin Massif, Fore-Sudetic Block, SW Poland – a part of the Ramzova overthrust? *Mineralogical Society of Poland, Special Papers*, 19: 131–134.

OBERC-DZIEDZIC, T., KLIMAS, K., KRYZA, R. & FANNING, M., 2000. SHRIMP zircon geochronology of the Neoproterozoic Strzelin gneiss: evidence for the Moravo-Silesian Zone affinity of the Strzelin Massif, Fore-Sudetic Block, SW Poland. *GeoLines*, 13: 96–97.

OBERC-DZIEDZIC, T., PIN, C., DUTHOU, J.L. & COUTURIE, J.P., 1996. Age and origin of the Strzelin granitoids (Fore-Sudetic Block, Poland): $^{87}Rb/^{86}Sr$ data. *Neues Jahrbuch für Mineralogie, Abhandlungen*, 171: 187–198.

OLIVER, G.J.H., CORFU, F. & KROGH, T.E., 1993. U-Pg ages from SW Poland: evidence for a Caledonian suture zone between Baltica and Gondwana. *Journal of the Geological Society, London*, 151: 1052–1076.

PATOČKA, F. & SZCZEPAŃSKI, J., 1997. Geochemistry of quartzites from the eastern margin of the Bohemian Massif (The Hrubý Jeseník Mts. Devonian and the Strzelin crystalline massif): provenance and tectonic setting of deposition. *Mineralogical Society of Poland, Special Papers*, 9: 151–154.

PUZIEWICZ, J., MAZUR, S. & PAPIEWSKA, C., 1999. Petrografia i geneza paragnejsów dwułyszczykowych metamorfiku Doboszowic (Dolny Śląsk) i towarzyszących im amfibolitów. [Petrography and origin of two mica paragneisses and amphibolites of the Doboszowice metamorphic unit (Sudetes, SW Poland)]. *Archiwum Mineralogiczne*, 52: 35–70.

SCHULMANN, K. &, GAYER, R., 2000. A model for a continental accretionary wedge developed by oblique collision: the NE Bohemian Massif. *Journal of the Geological Society, London*, 157: 401–416.

SKÁCEL, J., 1989. Hranice lugika a silezika (Středních a východních Sudet). [On the Lugicum-Silesicum boundary]. *Acta Universitatis Wratislaviensis, Prace Geologiczno Mineralogiczne*, 17: 45–55.

SUESS, F.E., 1912. Die moravischen Fenster und ihre Beziehung zum Grundgebirge des Hohes Gesenkes. *Denkschrifte der Osterreichisches Akademie der Wissenschaften*, 78: 541–631.

SUESS, F. E., 1926. Instrusiontektonik und Wandertektonik im variszischen Grundgebirge. Berlin: Borntreager, pp. 1–268.

SZCZEPAŃSKI J. MAZUR S. & WERNER T., 2000. Preliminary data on the AMS fabric in crystalline rocks from the West/East Sudetes contact zone in the Fore Sudetic Block – structural implications. *GeoLines*, 10: 72–74.

SZCZEPAŃSKI J., 1999. Mikrostrukturalna i petrologiczna charakterystyka warstw z Jegłowej w krystaliniku Wgórz Strzelińskich. (Unpublished PhD thesis). Wrocław University, Poland. {In Polish only}.

SZCZEPAŃSKI, J., 2001. Warstwy z Jegłowej – zapis wielofazowej deformacji w strefie kontaktu Sudetów wschodnich i zachodnich (krystalinik Wzgórz Strzelińskich, blok przedsudecki). [Jegłowa beds – record of polyphase deformation in the East and West Sudetes contact zone (Strzelin Massif, Fore Sudetic Block, SW Poland)]. *Przegląd Geologiczny*, 49: 63–71.

SZCZEPAŃSKI, J. & JÓZEFIAK, D., 1999. Jegłowa beds – record of polyphase deformation and metamorphism in the Strzelin crystalline massif. *Mineralogical Society of Poland special papers*, 14: 33–37.