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Stanisław Z. MIKULSKI[1]*, Bogusław BAGIŃSKI*[2]*, Piotr DZIERŻANOWSKI*[2]

THE CHIME AGE CALCULATION ON MONAZITE AND XENOTIME IN APLOGRANITE FROM THE SZKLARSKA PORĘBA HUTA QUARRY

Abstract: The CHIME method applied to monazite and xenotime from the Szklarska Poręba Huta aplogranite revealed ages 390±25 and 271±20 Ma. The oldest results indicate for xenotime formation in igneous/metamorphic conditions and the younger ages for magmatic (leucogranite formation at c.a. 294 Ma) and post magmatic hydrothermal processes (271±20 Ma).

Keywords: Sudetes, geochronology, monazite, xenotime

INTRODUCTION

The quarry of the aplogranite at Szklarska Poręba Huta is located in the western part of the Variscan Karkonosze Massif close to its contact with the Góry Izerskie metamorphic cover in the West Sudetes. In general at the quarry occur fine-crystalline aplogranite and medium- and coarse-crystalline monzogranites that are locally cut by aplite veins, pegmatite bodies (Gajda 1960, Pieczka, Gołębiowska 2002), and quartz veins with Sn-W-Mo-Bi mineralization (Karwowski et al. 1973; Kozłowski et al. 1975, Olszyński et al. 1976, Kozłowski et al. 2002). According to Pin et al. (1987) and Duthou et al. (1991), the Rb/Sr ages of the Karkonosze porphyritic (central) granites are 325-330 Ma old, and of the equigranural (range) and aplitic (granophyric) granites about 310 Ma. Additionally, the oldest ages have been dated at 350 Ma for two samples of ancient enclaves assimilated by granitic magma (Duthou et al. 1991).

METHODS AND RESULTS

Microprobe analyses have been carried out in selected polished thin sections of the aplogranite of porhyritic texture. Aplogranite consists mainly of quartz, plagioclase, microcline, biotite, sericite, chlorite, and ore minerals (Fe- and Ti-oxides). The considered samples were analyzed by use of the CAMECA SX-100 microprobe analyzer equipped with 3 wavelength-dispersive spectrometers. The operating conditions were: acceleration voltage - 20 kV, beam current - 50 nA and beam diameter – 2 µm. Natural and artificial materials have been used as standards

1 Polish Geological Institute, Rakowiecka 4, 00-975 Warsaw, e-mail: stanislaw. mikulski@pgi.gov.pl
2 Institute of Geochemistry, Mineralogy and Petrology, Warsaw University al. Zwirki i Wigury 93, 02-089 Warszawa, Poland; bobag@geo.uw.edu.pl

(for Pb - crocoite, for U - a synthetic glass with 5% of uranium, for Th - a synthetic glass with 5% of thorium). Pb Mβ (counting time - 300 sec.), U Mβ (counting time - 200 sec.) and Th Mα (counting time - 100 sec.) have been measured simultaneously with PET crystals. Analytical procedure were verified by comparison with the results obtained on homogenous crystals of monazite and zircon from the Suwalki massif dated additionally by isotopic method. Due to a high analytical error (±20 Ma) the peak interferences of U, Th and Pb have been omitted in this study. However, we decided to omitted also more reliable peak interferences of Th Mγ1 and U Mβ1 due to high and low concentration of Th that was within the error limit.

Table 1. The results of microprobe analyses of zircon, zirconolite-like phase, xenotime, and monazites (in weight %) from the Szklarska Poręba Huta quarry.

Oxides	**Zircon**	**Zirconolite-like phase**	**Xenotime**	**Monazite**	**Monazite**
SiO_2	32.215	25.658	0.513	1.005	2.696
ZrO_2	62.617	43.036			
Al_2O_3		0.943			
Nb_2O_5		0.499			
HfO_2	1.864	1.154			
P_2O_5	0.184	0.529	34.003	29.48	26.153
Y_2O_3	0.783	5.608	42.794	1.474	2.385
La_2O_3	0.004	0.003	0.028	13.271	11.362
Ce_2O_3	0.043	0.083	0.033	31.266	26.561
Pr_2O_3				3.497	3.083
Sm_2O_3			0.761	2.237	2.13
Nd_2O_3	0.006	0.181	0.383	13.09	10.831
Gd_2O_3	0.077	0.272	2.411	1.08	1.39
Dy_2O_3		0.646	4.788	0.265	0.427
Tb_2O_3	0.057	0.050	0.602	0.211	0.132
Ho_2O_3	0.060	0.208	1.080	0.101	0.148
Er_2O_3	0.173	0.867	3.968	0.154	0.086
Yb_2O_3	0.233	1.150	3.667	0.036	0
U_2O_3	1.078	1.736	0.666	0.304	0.44
ThO_2				2.334	11.181
FeO	0.325	2.900	0.441		
CaO		2.274		0.204	0.141
PbO			0.026	0.024	0.125
Total	99.719	87.797	96.164	100.033	99.271

Our detailed microprobe results confirmed the previous data presented by Pieczka & Gołębiowska (2002) about the variable and abundant occurrence of REE minerals at the Szklarska Poręba Huta quarry. Furthermore, we have been able to distinguish several new accessory minerals containing considerable amounts of REE and U. The most abundant minerals are: U-rich zircon, monazite, xenotime (Tab. 1), allanite, La-Ce davidite, gadolinite, yttrialite and other not well defined phases containing Y, Ti and HREE, Th, Si, Y. The mentioned minerals are of variable size, however their diameters are below 200 µm for zircon and xenotime and 50 µm for monazite and allanite, and 20 µm for other REE and U rich phases.
The CHIME age calculation method is based on the ratios between U, Th and Pb content in monazite, xenotime, or even in zircon (Suzuki, Adachi 1991). Additional advantage of this method is the possibility to study the changes in U, Th and Pb content within the zone structure of the mentioned minerals (Fig. 1b) that may reflect tectono-magmatic, or -metamorphic evolution of the studied rock. The ages were calculated with used of the MONAPD program obtained from dr. M. Kusiak from the Polish Academy of Sciences in Kraków.
In thin sections of the medium-grained aplogranite from Szklarska Poręba Huta, numerous xenotime and monazite crystals of diameter from a few to 200 µm have been detected using BSE image. Twenty five microprobe xenotime analyses gave the average results creating two distinguishing peaks at 390±25 Ma (the most distinct one) and at 274±20 Ma. Five monazite crystals (10 microprobe points analyzed) display somewhat younger ages not exceeding 295 Ma (average age 271±20Ma).

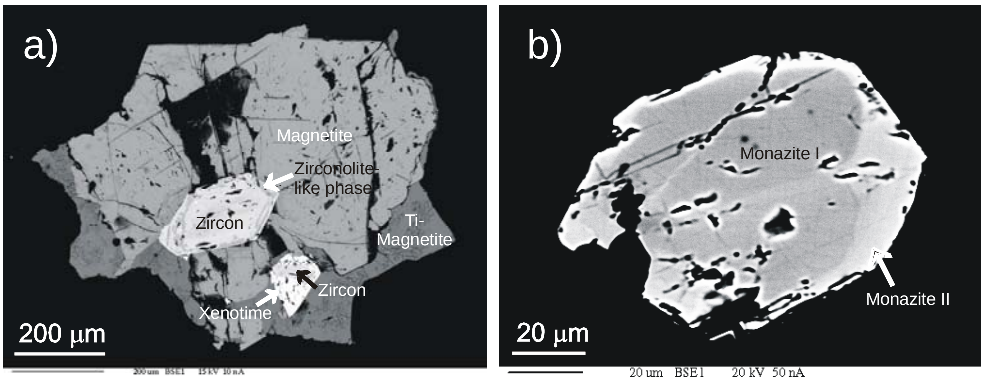

Fig. 1. BSE pictures of xenotime and zircon minerals in association with magnetite and Ti-magnetite (a) and monazites (b) in aplogranite from the Szklarska Poręba Huta quarry

CONCLUSIONS

The oldest dating result of euhedral xenotime is 390±25 Ma, and could be interpreted as an age of xenotime formation in igneous or metamorphic conditions. This age of xenotime formation is close to data presented by Timmerman et al. (2000) from the Góry Sowie Mountains. They obtained U-Pb age of the xenotime crystallization in pegmatite at 383-370 Ma that reflecting the anatectic event in that area. Obtained, younger ages of xenotime are roughly about 274±20 Ma, and could be interpreted as an ages of the youngest igneous stages of the Karkonosze intrusion – the formation of aplogranite (~294 Ma) and - post magmatic hydrothermal activities (274±20 Ma). The similar ages are obtained for monazite at 295 Ma (average age 271±20). However, it suggests that monazite grew only during the younger stage of xenotime growth and indicates the growth within the aplogranite what could be interpreted as the age (~295 Ma) of the aplogranite formation. According to our data the formation of the Sn-W-Mo-Bi mineral associations of pneumatolitic and hydrothermal types that are known from the Szklarska Poręba Huta quarry took place at *c.* 270±20 Ma.

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