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SECONDARY XENOTIME-LIKE MINERAL IN A PEGMATITIC FELDSPAR FROM GOŁASZYCE (STRZEGOM - SOBÓTKA GRANITOID MASSIF)

INTRODUCTION

Xenotime (Y,HREE)PO_4 is an accessory mineral present in granitic rocks of various composition and granitic pegmatites usually in very low amount but it can contain significant fraction of Y and HREE of the rock (Bea, 1996). Its fate in granitic rocks is important for understanding the processes of remobilisation of Y, U, and HRRE during alteration, stabilization of these elements during crystallization of secondary phases, interpretation of geochronological data and radioactive waste management.

In granites and pegmatites of the Strzegom–Sobótka massif, accessory phosphate phases (apatite, monacite and xenotime) are commonly present as small inclusions in biotite flakes. From all those phases xenotime is the least frequent although it is highly probable that it was not recognized due to its resemblance to zircon under optical microscope.

GEOLOGIC SETTING

The xenotime-like mineral investigated by the authors was obtained from the biotite granodiorite quarry at Gołaszyce located on a hill less than 1 km west of the village. The intrusion, forming the eastern part of the Strzegom–Sobótka granitic massif, solidified at the depth not exceeding 15 km, from water-poor, hot (>850˚C) magma derived probably from material of oceanic crust provenance about 280 Ma (Pin et al, 1989).

The Gołaszyce granodiorite is a light gray, massive rock consisting of plagioclases, alkali feldspars, quartz, biotite and accessory allanite, rutile, epidote, sphene, zircon, apatite and opaque phases (Majerowicz, 1972). It is cut by aplite and pegmatite veins that in places penetrate also the cover rocks. The thickness of the veins ranges from several centimeters up to well over a meter. Macroscopically, mineral phases forming the pegmatites comprise quartz, alkali feldspars and biotite as predominant constituents. Garnet and beryl are present in variable amounts as minor phases. The investigated sample consists of an automorphic crystal of a perthitic microcline separated out

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from a 40 cm thick pegmatite vein dipping at about 70⁻ towards SE. Two zones may be distinguished in the pegmatite from the margins inwards. The outer zone is built of alkali feldspars and quartz often forming graphic intergrowths whereas the center is dominated by big automorphic feldspars surrounded by smoky quartz mass. Biotite flakes tend to lay roughly perpendicular to the margins. Garnets are scarce and locally form garnet-quartz aggregates.

RESULTS

The xenotime-like mineral occurs in the microcline, with a mean composition of a potassic phase – $Ab_{4,7}An_0Or_{95,3}$, in a form of very thin veinlets filling small cracks. The veinlets are up to 2-3 μm thick and often split into numerous thinner veinlets (~0.1 μm thick) forming a complex network. Some veinlets follow phase boundaries in the perthite. Groups of nest-like accumulations of the material with similar composition can also be noted. The chemical composition of the material from veinlets varies within a broad range (Tab. 1). High content of Si, Al, Na, and Ca can be related to X-rays generated in feldspar in veinlets neighbourhood.

DISCUSSION OF RESULTS AND CONCLUSIONS

The chemical composition of the veinlets material indicates the presence of Fe-oxides. The presence of albite cannot be excluded. The proportion of HREE, Y, U corresponds to xenotime characterized by YPO_4 dominating over HREE-PO_4. Substitutions of coffinite ($USiO_4$) and brabantite ($CaTh(PO_4)_2$) are of minor importance. Surplus of P can be attributed to apatite or Fe phosphate. It should be noted that at the present state of study the presence of hydrated REE-Y phosphates (e.g. rhabdophane or churchite) cannot be ruled out.

Primary accessory minerals were probably the dominant source of HREE, Y, U, P in solution. Mobilization of elements was related to hydrothermal alteration of granite (cf. Cathelineau, 1987). Leaching of rocks from the granite surroundings can also be considered as a source of these elements. The occurrence of xenotime together with Fe oxides can indicate the mechanism of veinlets material precipitation. Scavenging of Y and REE by iron oxyhydroxides has been observed and experimentally measured (e.g. Bau, 1999). REE content in igneous-related hydrothermal Fe-oxide can be 5 – 50 times higher than in the associated rocks (Gleason et al., 2000). Low-temperature coating of minerals with high specific surface (as Fe or Mn oxyhydroxide) by U-rich (Y,HREE)-phosphate was described by De Putter et al. (1999). The temperature of formation of xenotime containing veinlets cannot be evaluated basing on the presented results. Both hydrothermal and weathering-related low temperature solutions could have controlled the origin of the veinlets.

The results of the study indicate Y, HREE, U, P, Cu, Pb, and Fe mobility during alterations of the Gołaszyce granite.

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Table 1. Selected analyses of veinlet material (recalculated to 100 wt.%; H2O and OH contents are neglected)(----- not determined using EDS)

Element (wt.%)	Point of analysis			
	21A-12-2	21A-12-1	21A-11-1	21A10-1
Si	18.28	20.48	35.22	26.61
Al	10.29	11.31	8.42	12.64
Na	2.79	3.12	3.39	4.99
Ca	2.00	1.80	1.80	2.30
Mg	0.16	-----	----	-----
Fe	38.14	33.06	22.40	11.43
Mn	0.74	0.43	0.47	----
S	0.38	0.42	0.38	0.63
Cu	1.14	1.57	0.62	----
Cl	0.21	----	----	----
P	5.40	8.05	6.32	10.57
Y	9.72	9.38	7.78	16.45
U	3.16	4.33	2.72	6.62
Th	----	0.05	0.18	----
Pb	0.70	----	1.05	0.96
Ce	----	----	----	0.42
Nd	0.51	0.07	0.49	----
Sm	0.64	0.35	----	0.58
Gd	1.77	1.17	1.64	1.20
Tb	2.42	----	1.20	----
Dy	----	----	3.40	1.83
Er	----	2.18	1.01	0.99
Tm	0.69	1.50	----	----
Lu	0.03	----	0.27	----
Yb	----	----	----	1.79

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