POLSKIE TOWARZYSTWO MINERALOGICZNE – PRACE SPECJALNE
MINERALOGICAL SOCIETY OF POLAND – SPECIAL PAPERS
Zeszyt 24, 2004; Volume 24, 2004

Eligiusz SZEŁĘG[1], Andrzej CIURLA[1]

PRELIMINARY DATA ON Nb-Ta OXIDES IN PEGMATITES FROM STRZEGOM-SOBÓTKA MASSIF (LOWER SILESIA, POLAND)

Abstract: Formanite-(Y), fergusonite-(Y) and tantalaeschynite-(Y) were found in a miarolitic pegmatite in the Paszowice quarry (western part of the Strzegom-Sobótka massif) as inclusions within cassiterite and microcline. The crystal chemical formula of formanite-(Y) is $(Y_{0.50\text{-}0.71}U_{0.01\text{-}0.03}Th_{0.00\text{-}0.03}Sc_{0.07\text{-}0.16}Nd_{0.01\text{-}0.04}Sm_{0.00\text{-}0.04}Gd_{0.01\text{-}0.06}Dy_{0.02\text{-}0.09}Ho_{0.00\text{-}0.02}Er_{0.03\text{-}0.06}Yb_{00.06\text{-}0.07}Zr_{0.00\text{-}0.01})(Ta_{0.44\text{-}0.54}Nb_{0.26\text{-}0.36}Fe_{0.06\text{-}0.08}Mn_{0.03\text{-}0.05}W_{0.01\text{-}0.02}Sn_{0.01\text{-}0.05}Ti_{0.00\text{-}0.01})O_4$, fergusonite-(Y): $(Y_{0.73\text{-}0.85}Nd_{0.01\text{-}0.02}Sm_{0.01}Gd_{0.02\text{-}0.04}Dy_{0.02}Ho_{0.01}Er_{0.03}Yb_{0.06\text{-}0.07})(Nb_{0.62\text{-}0.64}Ta_{0.34\text{-}0.35}Ti_{0.01\text{-}0.02}W_{0.01})O_4$ and tantalaeschynite-(Y): $(Y_{0.77}U_{0.01}Sc_{0.03}Sm_{0.01}Gd_{0.02}Dy_{0.04}Ho_{0.01}Er_{0.05}Yb_{0.08})(Ta_{1.08}Ti_{0.60}Nb_{0.22}Fe_{0.06}W_{0.02}Sn_{0.01})_{\Sigma 2}O_6$. Those oxides are primary Nb-Ta-REE minerals in pegmatites in Strzegom-Sobótka massif.

Keywords: fergusonite-(Y), formanite-(Y), tantalaeschynite-(Y), pegmatite, granite, Strzegom, Poland

INTRODUCTION

Granites and granodiorites form the Variscan Strzegom-Sobótka massif (Majerowicz 1972, Puziewicz 1989). Miarolitic pegmatites occur in the western part of the massif (Schwantke 1896, Żabiński 1953, Lenkowski 1983, Janeczek 1985). Those pegmatites have yielded over 60 mineral species. The occurrence of fergusonite in Strzegom was reported by German mineralogist (Websky 1879, Traube 1888, Schwantke 1896, Gürich 1917). Janeczek (1985) considered the occurrence of fergusonite in Strzegom pegmatites as probable, but unproved, because papers of German researchers did not contain sufficient data to allow for on unequivocal identification of fergusonite. Chabros et al. (2002) reported unspecified Nb-Ta oxides from the Graniczna quarry, which consisted of 22.30 wt. % Nb_2O_3 and 18.90 wt. % Ta_2O_3.

In this paper we describe Nb-Ta oxides from miarolitic pegmatite within biotite-hornblende granite in the Paszowice quarry near Jawor (western part of the Strzegom-Sobótka massif).

SAMPLE DESCRIPTIONS

Rock-forming minerals of the miarolitic pegmatite include bluish-green microcline (amazonite), quartz and albite. Fluorite, post-biotitic chlorite and cassiterite are accessory minerals. Cassiterite was found in the graphic intergrowths

[1] *University of Silesia, Faculty of Earth Sciences, Będzińska 60, 41-200 Sosnowiec, Poland, e-mail: szeleg@wnoz.us.edu.pl*

zone of the pegmatite. Dark brown crystal of cassiterite is 0.5 long and 0.2 mm wide. Intergrowths of cassiterite and microcline were observed. Nb-Ta oxides form small prismatic or xenomorphic inclusions within both cassiterite and microcline (Figs. 1 & 2).

ANALYTICAL METHODS

The grain of cassiterite was hand-picked and mounted in a resin for electron-probe microanalysis.

Preliminary observations by back-scattered electrons (BSE) were carried out using ESEM – XL 30 TMP (Philips/FEI) scanning electron microscope equiped with EDS (EDAX) detector. Electron-probe microanalyses in the wavelength-dispersive (WDS) mode and BSE images were performed using a Cameca SX 100 in the Inter-Institutional Laboratory of Microanalysis of Minerals and Synthetic Substances at the Faculty of Geology, Warsaw University.

RESULTS

Chemical compositions of Nb-Ta oxides are given in Table 1. Those chemical compositions can be attributed to the presence of formanite-(Y), fergusonite-(Y), and tantalaeschynite-(Y). Number of ions was calculated based on 4 oxygens for formanite-(Y) (Y,...)(Ta,Nb)O_4 and fergusonite-(Y) (Y,...)(Nb,Ta)O_4, and on 6 oxygens for tantalaeschynite-(Y) (Y,...)$(Ta,Nb,Ti)_2O_6$. In formanite-(Y) Sc, REE, actinides and Zr substitute Y, whereas Nb, Fe, Mn, W, Sn and Ti replace Ta. Scandium occupies up to 16 atom percent of the Y site in formanite-(Y). In fergusonite-(Y) REE and actinides substitute Y, whereas Ta, W and Ti replace Nb. In tantalaeschynite-(Y) REE, Sc and actinides substitute Y, whereas Ti, Nb, Fe, W and Sn replace Ta. Titanium occupies 30 atom percent of the Ta site in tantalaeschynite-(Y). The Nb-Ta oxides can contain hydroxyl groups, which might explain low totals in all micro-chemical analyses.

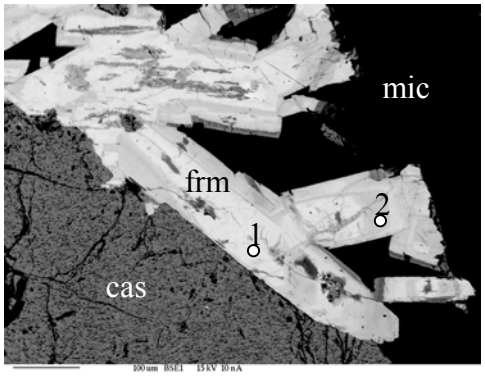

Fig. 1. BSE image of formanite-(Y) (frm) between cassiterite (cas) and microcline (mic). 1, 2 – analytical points.

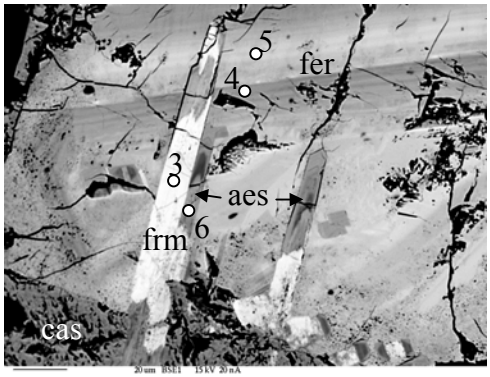

Fig. 2. BSE image of formanite-(Y) (frm) and tantalaeschynite-(Y) (aes) in fergusonite-(Y) (fer). 3-6 – analytical points.

Table 1. Chemical compositions of Nb-Ta oxides from Paszowice quarry, wt. %.

	1	2	3	4	5	6
Ta_2O_5	44.02	38.41	47.69	26.23	25.81	40.06
Nb_2O_5	14.07	18.92	13.57	29.20	27.37	4.86
FeO	4.59	4.17	4.46	n.d.	n.d.	1.47
MnO	2.53	2.81	1.61	n.d.	n.d.	0.10
ZrO_2	0.21	0.34	0.47	0.03	0.01	0.09
HfO_2	n.d.	0.01	0.12	n.d.	n.d.	0.13
WO_3	2.55	3.79	3.07	1.19	1.61	1.66
SnO_2	4.97	5.55	3.99	n.d.	0.02	0.65
TiO_2	0.48	0.20	1.02	0.55	0.86	16.25
Y_2O_3	8.36	10.41	14.11	31.72	26.09	20.01
UO_2	2.23	1.18	0.95	0.12	0.29	0.76
ThO_2	2.16	1.34	n.d.	0.08	0.38	n.d.
Sc_2O_3	0.69	0.80	1.90	0.03	0.06	0.40
Nd_2O_3	0.94	0.81	0.17	0.41	1.19	0.04
Sm_2O_3	1.00	0.98	0.13	0.46	1.37	0.39
Gd_2O_3	1.62	1.37	0.25	0.95	2.39	0.71
Dy_2O_3	2.53	2.28	0.74	1.43	3.22	1.82
Ho_2O_3	0.58	0.20	n.d.	0.56	0.86	0.49
Er_2O_3	1.80	1.59	0.86	1.66	2.61	1.98
Yb_2O_3	2.13	2.04	2.17	3.64	4.22	3.54
Total	97.46	97.20	97.28	98.26	98.36	95.41
Ta	0.52	0.44	0.56	0.34	0.35	1.08
Nb	0.28	0.36	0.26	0.64	0.62	0.22
Fe	0.08	0.07	0.08	0	0	0.06
Mn	0.05	0.05	0.03	0	0	0
Zr	0	0	0.01	0	0	0
Hf	0	0	0	0	0	0
W	0.01	0.02	0.02	0.01	0.01	0.02
Sn	0.04	0.05	0.03	0	0	0.01
Ti	0.01	0	0.02	0.01	0.02	0.60
Y	0.50	0.58	0.71	0.85	0.73	0.77
U	0.03	0.01	0.01	0	0	0.01
Th	0.03	0.02	0	0	0	0
Sc	0.07	0.07	0.16	0	0	0.03
Nd	0.04	0.03	0.01	0.01	0.02	0
Sm	0.04	0.04	0	0.01	0.03	0.01
Gd	0.06	0.05	0.01	0.02	0.04	0.02
Dy	0.09	0.08	0.02	0.02	0.05	0.04
Ho	0.02	0.01	0	0.01	0.01	0.01
Er	0.06	0.05	0.03	0.03	0.04	0.05
Yb	0.07	0.07	0.06	0.06	0.07	0.08

1-3 – formanite-(Y), 4-5 – fergusonite-(Y), 6 – tantalaeschynite-(Y),
n.d. – not determined

Formanite-(Y) and fergusonite-(Y) form solid solution series. In the investigated sample those minerals occur as two independent phases. Fergusonite-(Y) forms xsenomorphic grains with oscillatory zoning caused by changes in chemical compositions (Fig. 2). Formanite-(Y) forms idiomorphic zonal prismatic crystals (Fig. 1). They may co-occur with tantalaeschynite-(Y) (Fig. 2). The minerals are optically anisotropic; therefore, they are not metamict.

A sequence of crystallization of Nb-Ta oxides was determined using BSE images. Formanite-(Y) crystallized together with tantalaeschynite-(Y) prior to fergusonite-(Y). Cassiterite formed after the crystallization of Nb-Ta oxides. The presented description suggests that crystallization of Nb-Ta oxides was followed by quartz-microcline-cassiterite paragenesis in the graphic zone of pegmatite. According to Janeczek (1985) that zone formed at temperatures about 550 – 400 ^{o}C, which corresponded to the early stage of pegmatite formations.

CONCLUSIONS

Formanite-(Y), fergusonite-(Y) and tantalaeschynite-(Y) are primary Nb-Ta-REE minerals and formed at the early stages of the evolution of pegmatites in the Strzegom-Sobótka massif.

ACKNOWLEDGEMENTS: The authors thank Prof. Łukasz Karwowski and Dr. Piotr Dzierżanowski for help in electron-probe microanalyses.

REFERENCES

CHABROS E., DZIERŻANOWSKI P., KOZŁOWSKI A., 2002: Post-magmatic rare-earth-element mineralisation in the Granitoid Strzegom massif, SW Poland. Mineralogical Society of Poland – Special Papers, 20: 71-73.

GÜRICH G., 1917: Die Ergebnisse der Aufnahmen auf Blatt Striegau bis 1911. Jb. Preuss. Geol. Landesanst. Bd 36.

JANECZEK J., 1985: Typomorficzne minerały pegmatytów masywu strzegomskiego. Geol. Sudetica, 20 (2): 1-62.

LENKOWSKI W., 1983: Fizykochemiczne warunki krystalizacji nisko- i średniotemperaturowych paragenez mineralnych w masywie strzegomskim. Arch. Miner., 39 (1): 53-66.

MAJEROWICZ A., 1972: Masyw granitoidowy Strzegom-Sobótka. Studium petrologiczne. Geol. Sudetica, 6: 7-96.

PUZIEWICZ J., 1989: Masyw granitoidowy Strzegom-Sobótka. Aktualny stan badań. Arch. Miner., 45 (1-2): 135-154.

SCHWANTKE A., 1896: Die Drusenmineralien des Striegauer Granits. Leipzig.

TRAUBE H., 1888: Die Minerale Schlesiens. Breslau.

WEBSKY M., 1879: Über Aphrosiderit von Striegau. Z. Deutsch. Geol. Ges. Bd 31.

ŻABIŃSKI W., 1953: Minerały pegmatytowe strzegomskiego masywu granitoidowego. Prz. Geol., 3.