Tomasz PAWLIK[1]*, Michał SACHANBIŃSKI*[1]

APATITE-BEARING GNEISSES FROM ROŚCISZÓW IN SOWIE MTS. (SW POLAND)

Abstract: Homophanic gneisses near Rościszów (Sowie Mts.) host an inlier of apatite-bearing variety. The apatite is represented by two generations of fluorapatite of distinct composition and structure. The apatite-bearing gneisses originated from fine-grained sandstones and mudstones locally enriched in Ca phosphates.
Keywords: fluorapatite, apatite-bearing gneisses, homophanic gneisses, Sowie Mts., WDS

INTRODUCTION

The 25 m long inlier of apatite-bearing rock occurs within gneissic rocks about 1-1.5 km west of Rościszów on the left bank of the Kłomnica stream. The rock is a mostly homophanic gneiss (migmatite) with locally preserved layering, medium- and coarse-grained, composed of oligoclase, biotite, quartz and apatite. Zircon, muscovite, ore minerals and garnet are present as accessory phases. The latter forms crystals up to 1 cm in diameter. Apatite content reaches 3 vol % while the amount of P_2O_5 is 1.8 vol % (Sachanbiński 1975). The apatite usually forms macroscopically discernible about 0.5-1 cm big green aggregates along feldspar-quartz boundaries. Rarely it is represented by 0.5-2 mm long single crystals and often constitutes minute inclusion in feldspar. The apatite crystals from the aggregates are isometric, oval or irregular, usually strongly fractured. The metamorphic conditions of the diatexite (homophanic gneiss) enclosing the apatite-bearing rock were estimated at 585±20°C (Grt-Bt geothermometer) or 610±22°C (Mu-Bt geothermometer) and 5.9-0.9 kbar (Mu geobarometer), (Budzyń et al. 2004).

METHODS

Detailed investigations were focused on apatite from the homophanic gneisses. The WDS analyses and BSE images were obtained by means of a CAMECA SX-100 microprobe at the Inter-Institution Laboratory of Microanalyses of Minerals and Synthetic Substances at Warsaw University. Structural measurements were performed with a Jobin-Yvon T-64000 Raman spectrometer using an argon laser (λ=514.5 nm) at the Department of Molecular Physics, Technical University of Łódź.

[1] *Institute of Geological Sciences, University of Wrocław, pl. M. Borna 9, 50-205 Wrocław, Poland, tomp@ing.uni.wroc.pl, msach@ing.uni.wroc.pl*

RESULTS

36 spot chemical analyses of the apatites from Rościszów were made. They revealed a presence of two chemically different varieties that could be distinguished on BSE images. First generation (apatite I) constitutes the main apatite volume whereas the other (apatite II) is noticeably darker in BSE and forms more or less regular zones developed along fracture planes in apatite I (Fig.1).

Tab. 1. Selected chemical electron microprobe analysis of apatites from Rościszów.

weight percent of oxides (based on 25 oxides)				
sample	**R2 apI**	**R6 apI**	**R5 apII**	**R9 apII**
SO_3	-	0,03	0,004	-
P_2O_5	41,965	42,231	41,978	43,044
SiO_2	0,024	0,024	-	0,005
ThO_2	0,066	0,105	-	0,033
UO_2	-	-	0,053	0,038
Al_2O_3	-	-	-	-
Fe_2O_3	0,131	0,318	0,001	0,09
Y_2O_3	0,267	0,375	0,071	0,143
La_2O_3	0,277	0,024	-	-
Ce_2O_3	0,095	0,114	0,142	0,058
Nd_2O_3	0,359	0,259	0,2	-
MgO	0,023	0,051	-	0,007
CaO	54,118	53,978	55,025	55,445
MnO	0,196	0,347	0,042	0,13
SrO	tr	tr	tr	tr
Na_2O	0,165	0,191	0,017	0,115
H_2O	0,729	0,703	0,647	0,871
F	2,137	1,953	2,349	2,237
Cl	0,13	0,081	0,061	0,062
total	100,682	100,048	100,590	100,134

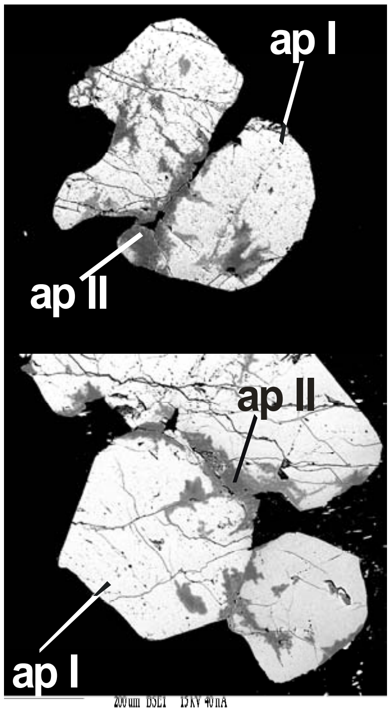

Fig. 1. Apatite from Rościszów: apatite I (ap I) and apatite II as veinlets (ap II).

The chemical composition obtained (amount of Ca, Na, P, Mn, Fe, Cl and F) corresponds with the one for fluorapatite from felsic rocks (Spear & Pyle 2002). The analyses show that apatite II contains less Ce, La, Nd, Y, Na, S, Si and Cl than apatite I (Tab. 1).

The presence of two apatite generations was confirmed by micro-Raman structural analyses. All the Raman spectra show bands at 430 cm^{-1} (E_{2g}: ν_2 $[PO_4]$

bend), 580 cm^{-1} (E_{2g}: ν_4 [PO_4] bend), 605 cm^{-1} (E_{2g}, A_g: ν_4 [PO_4] bend) and 965 cm^{-1} (E_{2g}, A_g: ν_1 [PO_4] symmetric stretch). Weak bands at 448 cm^{-1} (E_{2g}: ν_2 [PO_4] bend), 590 cm^{-1} (E_{2g}: ν_4 [PO_4] bend), 1050 cm^{-1} (E_{2g}: ν_3 [PO_4] anti-symmetric stretch) and 1080 cm^{-1} (E_{2g}: ν_3 [PO_4] anti-symmetric stretch). Spectral positions of the bands correspond to the values for fluorapatites given by other authors (Penel et al. 1997; William & Knittle 1995). The spectra of apatite I and apatite II differ in the range of 580-610 cm^{-1}. Irrespective of apatite I crystal orientation there always appear two weak but clear and sharp bands ~580 and ~605 cm^{-1} (sometimes also weak ~590 cm^{-1}). These bands become weaker, broader and diffused to form a broad and weak feature in all the spectra of apatite II. The Ramana spectra of apatites from Rościszów are depicted on Fig. 2.

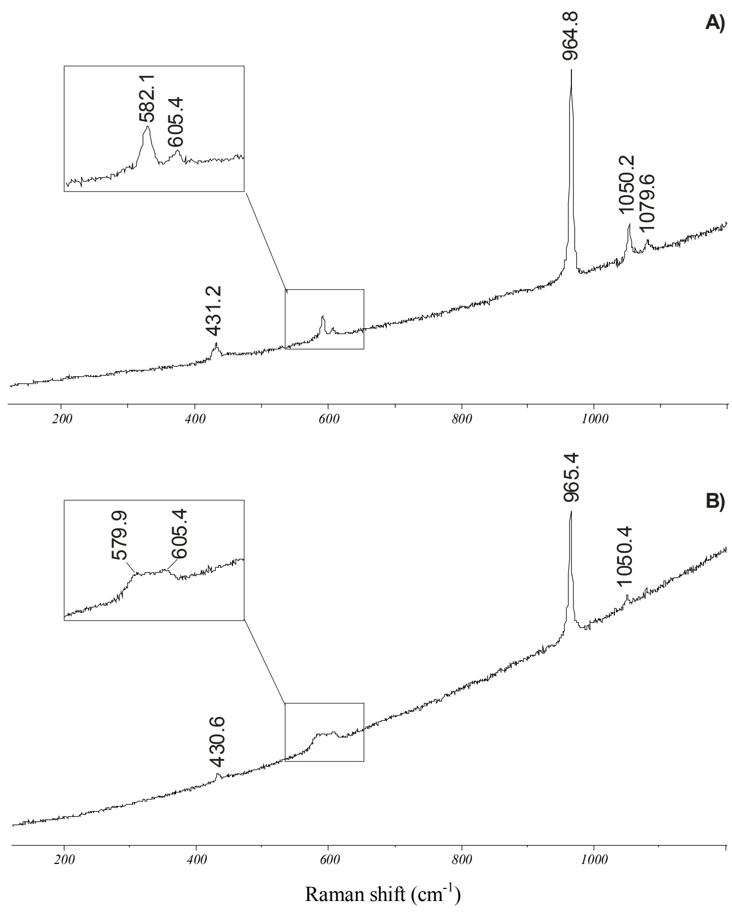

Fig. 2. Selected Raman spectra of apatite I (A) and apatite II (B).

CONCLUSIONS

Apatite-bearing gneisses from Rościszów may have been derived from locally Ca-enriched sandstones and/or mudstones. Metamorphic alterations led to structural rebuilding of Ca phosphates and enrichment in P_2O_5 and F at the expense of CO_3^{2-} and OH^- ions. As a result fluorapatites were formed. Chemical composition of the apatites from the Rościszów gneiss allows an attempt to reconstruct the metamorphic conditions. It is generally acknowledged that apatites from metamorphic rocks are characterised by small amount of Ba, REE, Na and Mn. Rocks metamorphosed at high temperatures contain more of these elements as well as SiO_2 while SO_3, CO_2 and Cl decrease significantly (Kapustin 1987, Spear & Pyle 2002).

The differences in chemical composition and structural features of the apatites, manifested by higher concentration of Si, REE and Na in apatite I, may be explained by its crystallisation at higher temperature. The other generation was formed at lower temperatures.

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