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**FLUID INCLUSIONS IN BERYLS FROM PEGMATITES OF THE
SUDETY MTS (BIELAWA, PIŁAWA GÓRNA, SIEDLIMOWICE)**

INTRODUCTION

Samples of beryls were collected in the pegmatites of: 1. the eastern part of the Strzegom- Sobótka granitoid massif (Sedlimowice), 2. the north-eastern part of the Sowie Mts gneiss block: a) pegmatite localised in a cropfield between Bielawa and Myśliszów; b) an old feldspar quarry in Piława Górna south of the railway line.

Most of the beryls from the Sudety Mts contain abundant fluid inclusions (FI) from 5 to 50 µm in size. Most of the inclusions are arranged parallel to the c axis of crystals, therefore, parallel to the elongation of the prism. Less inclusions are perpendicular to the c axis and form longitudinal streaks. In some crystals FI mark growth zones. Some primary inclusions exist isolated.

Protogenetic solid inclusions (SI), typical of beryls from pegmatites, were discerned in all the specimens studied. These SI are common in the rock-forming and accessory minerals of the beryl host rocks, e.g.: garnets, muscovite, columbite in beryls from granitic pegmatites of the eastern part of the Strzegom-Sobótka massif and albite, apatite, microcline, muscovite, quartz, schörl in beryls from pegmatites of the Sowie Mts gneisses.

METHODS

Double polished wafers about 0.2 mm thick were glued with epoxy on 1.6 mm thick glass plates. After microscopic examination, the wafers were removed from the plates using acetone and prepared for heating and freezing analyses. Microthermometric data were obtained with a Linkam THMSG 600 heating-freezing stage from (-196 to +600⁰C) mounted on a Nikon Eclipse E600 microscope equipped with 20×, 50× and 100× long working distance Nikon objectives.

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RESULTS

Two main types of primary FI were distinguished in the beryl crystals studied: a) two-phase, irregular, parallel to basal pinacoid or the c axis, 5-48 μm in diameter (Siedlimowice, Bielawa, Piława Górna); b) two-phase, regular, rectangular, parallel to the c axis, 9-52 μm in diameter (Siedlimowice).

Upon cooling from room temperature to -190°C no additional phases nucleated. Upon heating solid CO_2 melted over the temperature range -58.6 to -55.4°C . Continued heating resulted in continuous melting of ice, however, the initial melting of ice ($T_{\text{m(in)}}$) started at -12.9°C . The ice melting temperature was from -9.4 to -0.2°C . Further heating revealed final clathrate melting temperatures 9°C ($T_{\text{m(cia CO}_2\cdot 5.75\text{H}_2\text{O})}$) but only in two FI in sample from Siedlimowice. Further heating resulted in homogenisation of the carbon dioxide fluid (ThCO_2) into vapour over temperature range 25.4 - 28.4°C (Siedlimowice). Final homogenisation to the liquid ($\text{Th}_{\text{tot V}\rightarrow\text{L}}$) took place over the temperature range from 196.8 to 333.8°C , i.e.: Siedlimowice – $\text{Th}_{\text{tot}} = 196.8$ – 333.8°C (mainly 200 – 249°C); Piława Górna – $\text{Th}_{\text{tot}} = 208.8$ – 256.3°C ; Bielawa – $\text{Th}_{\text{tot}} = 200$ – 310°C (mainly 200 – 230°C). Secondary FI gave Th_{tot} from 149.5 to 310°C .

The carbonic phase melted at temperatures range from -58.6 to -55.4°C , indicating the possible presence of small concentrations of CH_4 and/or N_2 . $T_{\text{m(in)}} = -12.9^{\circ}\text{C}$ indicates the presence of NaCl solution in beryls from Siedlimowice.

Initial total mole fraction CO_2 (XCO_2 , Siedlimowice) in the aqueous phase is estimated at 2.55 mol% (Diamond 2001). This is obtained from the maximum CO_2 solubility in the aqueous phase in the H_2O - CO_2 binary. Internal FI pressure at the average $T_{\text{m(cia)}}$ is estimated at 43 bars using method of Duan et al. (1992a). $T_{\text{m(cia)}}$ corresponds to an average salinity of 2.07 wt.% NaCl eq. (Diamond 2001). Using these assumptions an average FI composition of 0.9672 mol% H_2O , 0.0233 mol% CO_2 , 0.0022 mol% CH_4 and 0.0073 mol% NaCl (2.07 wt.% NaCl eq.) and an estimated bulk molar volume of $24 \text{ cm}^3/\text{mol}$ were determined. Density of 1.0026 g/cm^3 and corrected pressure of ca 44 MPa were obtained using equations of Touret and Huizenga (1993) and Duan et al. (1992b). FI in beryls from Siedlimowice represent H_2O - CO_2 - CH_4 -NaCl chemical system and from the Sowie Mts, Bielawa and Piława Górna, CO_2 - CH_4 chemical system.

DISCUSSION AND CONCLUSION

The results obtained point out that beryls from the Strzegom-Sobótka massif are of postmagmatic origin and precipitated from hydrothermal solutions, and from the Sowie Mts gneiss block are of the so-called 'dry fluids', postmagmatic in origin.

The estimated chemical composition of FI in beryls from the Strzegom-Sobótka massif is consistent with the results of Marcinowska and Kozłowski (1998) who noticed that majority of inclusions in the minerals from the Strzegom pegmatites are filled with water solutions of various densities and brine concentrations. These

authors relate such solutions to an initial hydrothermal stage and temperatures about 450°C.

In this paper, authors relate beryl precipitation to the final stage of pegmatite crystallisation at the temperature range between 200 and 350°C, where episodic presence of CO₂ vapour might have happened with minor quantities of water fluids.

A relatively narrow range of Th_{tot} mainly between 200 and 250°C indicates that beryl crystallisation in the Sudetic pegmatites could be a single-stage process at gradually decreasing temperature. Similar Th_{tot} values obtained Włodyka et al. (1983) for the beryls from the Izera Mts, and also Janeczek and Sachanbiński (1989) for the beryls from the eastern part of the Strzegom-Sobótka granitoid massif (360-200°C).

The authors suggest the tectonic-controlled hydrothermal model of beryllium mineralisation. Fluids rich in beryllium might have migrated along deep fracture zones of regional and/or local significance. It must be emphasized that beryls occur along the eastern margin of the Strzegom-Sobótka massif, relatively close to the contact zone with the Słęża gabbro as well as in the Sowie Mts beryls close to the Sudetic Marginal Fault than in central part of the mountain range.

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