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FLUID INCLUSIONS IN QUARTZ FROM METAPELITES OF THE STARA KAMIENICA CHAIN, SUDETES, POLAND

INTRODUCTION

The metapelite Stara Kamienica complex (chlorite-mica-quartz schists with garnets, cf. e.g. Kozłowski 1974, Marcinowska 2002) of the Izera area in the northern metamorphic cover of the Karkonosze granitoid massif in Sudetes (Mazur 2002) forms a west-east stripe within the so-called Izera gneisses and granite-gneisses (Kozłowska-Koch 1965) of the age ca. 500 Ma (Borkowska et al. 1980). The schists host the cassiterite-polymetal and Co mineralization (Szałamacha, Szałamacha 1974, Wiszniewska 1984), which is out of scope of the current study and fluid inclusions in the quartz of the ore parageneses were described elsewhere (Kozłowski 1978, Wiszniewska et al. 1998).

SAMPLES AND METHODS

The 174 samples of quartz were collected from the studied complex, among which 139 samples were appropriate for the fluid inclusion studies. The studied samples came from the whole length of the Stara Kamienica chain (76 samples) and from three N–S logs at the settlements of Proszowa (17 samples), Krobica (22 samples) and Czerniawa Zdrój (24 samples). The sampling points were selected to avoid the signs of the ore mineralization. From each sample two to four double-side polished preparations 0.2–0.5 mm thick were prepared. The routine homogenisation and freezing methods were applied for the investigated inclusions (Roedder 1984); the dual-purpose heating–freezing microscope stage (type Fluid Co.) was used. For the calculations of the fluid inclusion data the programme *Fluids*, kindly supplied by Dr. Ronald Bakker from the Montanuniversität Leoben, was used.

FLUID INCLUSIONS

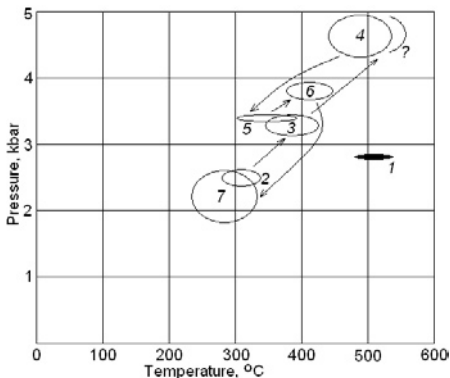
The total of 2340 inclusions was investigated in all the 139 samples. This number does not include 711 inclusions in 54 preparations made from other 29 samples, in which the compositions of solutions and gases were studied earlier (Marcinowska, Kozłowski 1997). The characteristic, given in the latter publication, albeit consistent with the currently obtained data, will not be repeated here. The present elaboration will discuss only crystallization temperatures, pressures and salt concentrations of the

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parent solutions of quartz, obtained from fluid inclusions in this study. The characteristics of the inclusions, filled with nitrogen, carbon dioxide and methane, used for calculations of the temperatures and pressures of crystallization of quartz, were presented earlier (Marcinowska, Kozłowski 1997).

The following seven types of aqueous inclusions were found in the recent studies (listed in sequence of formation, from the oldest to the youngest ones):

1. Inclusions, which occurred rarely, <1 μm to 7 μm in size, filled by solution of the total salinity (S) of 16–27 wt. %. The inclusions up to 3 μm had no signs of changes of their vacuoles and yielded temperatures (T_{cr} ; here and later the temperatures of crystallization) from 480 to 540°C and pressures (P) ca. 2.8 kbar. However, the larger ones showed evident leakage and did not yield any consistent temperature and pressure data. Such inclusions occurred in small (1–2 mm) “grains” of quartz, separated from the surrounding quartz by a zone of submicrometer-size inclusions of silicates of iron and magnesium with variable aluminium and occasional potassium presence (Cameca $\times 100$ electron probe determinations). These tiny mineral grains probably were micas and chlorites.



2. Inclusions of aqueous solutions with S 7–9 wt. %, T_{cr} 280–340°C, P 2.4–2.6 kbar; those, that were 1–4 μm in size, had no signs of leakage, the larger ones were damaged.

3. Inclusions of aqueous solutions with S 16–20 wt. %, T_{cr} 350–420°C, P 3.1–3.4 kbar; small part of the inclusions, which were larger than 4 or 5 μm , were damaged.

Fig. 1. Pressure and temperature changes during metamorphism of the Stara Kamienica schists.

4. Inclusions of aqueous solutions with S 17–23 wt. %, T_{cr} 440–530°C, P 4.3–4.9 kbar; few, not very reliable determinations yielded T_{cr} ca. 550°C; inclusions smaller than 4 μm , some with apparent stretching traces.

5. Inclusions of aqueous solutions with S 13–14 wt. %, T_{cr} 300–390°C, P 3.3–3.4 kbar; inclusions were smaller than 3 μm .

6. Inclusions of aqueous solutions with S 16–20 wt. %, T_{cr} 380–440°C, P 3.7–3.9 kbar; inclusions were smaller than 5 μm .

7. Inclusions of aqueous solutions with S 8–13 wt. %, T_{cr} 330–230°C, P 1.8–2.6 kbar; inclusions were smaller than 10 μm .

CONCLUSIONS

The fluid inclusion study in metamorphic quartz from the schists of the Stara Kamienica belt indicated, that some relic quartz grains contain probably pre-metamorphic inclusions (type 1). Metamorphic fluid inclusions recorded the events at T_{cr} 280–

340°C, P 2.4–2.6 kbar, T_{cr} 350–420°C, P 3.1–3.4 kbar, T_{cr} 440–530°C, P 4.3–4.9 kbar, T_{cr} 300–390°C, P 3.3–3.4 kbar, T_{cr} 380–440°C, P 3.7–3.9 kbar and T_{cr} 330–230°C, P 1.8–2.6 kbar (Fig. 1). Note the increased P and T of the metamorphic process evidenced by the inclusions of the type 6.

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