Cordierite-Bearing Rocks and their Relation to the PT Evolution of Rocks in the N Parts of the Zábřeh and Polička Crystalline Complexes

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The Zábřeh and Polička crystalline complexes have been divided into different geological units by most of the authors (e.g., Mísař et al. 1983). In spite of this, the two complexes exhibit many similar lithological and petrographic features.

The Zábřeh Crystalline Complex (ZCC) can be subdivided into two parts according to the metamorphism and lithology. These parts are separated by a belt of staurolite mica-schists and phyllites along the Moravská Sázava River. The northern part is formed by quartzitic gneisses with intercalations of quartzite and metarhyolite, biotite gneisses with garnet and sillimanite, pearl gneisses and migmatites with amphibolite. The southern part is composed of phyllites with numerous intercalations of amphibolites, rare bodies of acidic metavolcanics and metadiorites.

The Polička Crystalline Complex (PCC) has a somewhat more simple structure, and it is similar to the ZCC northern part. The PCC is dominated by two-mica gneisses, biotite gneisses and less frequent sillimanite gneisses, with staurolite mica-schists along the NE border. Narrow bands of amphibolites can be found along the whole crystalline complex, being often accompanied by marbles and calc-silicate rocks.

Metamorphic complexes have a similar character in both units. They are formed by muscovite-biotite to biotite gneisses intercalated with quartzites, amphibolites and meta-carbonate rocks. Metapelites commonly contain graphite pigment. Metamorphic rocks were intruded by tonalite to granodiorite bodies. The calculation of PT conditions employed composition of fluid phase determined by Janák et al. (1999) for similar rocks, i.e., XH2O = 0.7.

Cordierite-bearing rocks have been reported only from the northern part of the PCC. The locality is situated some 500 m from the E margin of the Miřetín intrusion. Mineral assemblage (Pl + Q + Bi ± Ms) is typical for biotite gneisses adjacent to cordierite chert. The cherts are fine-grained rocks possessing post-metamorphic foliation planes. Their mineral assemblage is: Pl + Q + Bi + Cor + Grt ± And ± St ± Chl, but cordierite was completely replaced by chlorite. Garnet grains are automorphic, being enclosed in cordierite. Rare andalusite is xenomorphic, staurolite forms relics enclosed in cordierite or andalusite. The peak conditions of the origin of this mineral association were calculated at 565 °C and 2.5 to 3 kbar. Its formation seems to be partly governed by the reaction St + Bi = Grt + Cor or reaction And + Bi = Cor + Grt. The ambient rocks show no signs of metamorphism of higher grade than that which affected the cherts. Mineral assemblage Mu + Bi + Sill ± Grt was found in gneisses in the proximity of tonalites in other parts of the crystalline complex.

Cordierite is more common in gneisses of the ZCC. Cordierite is typical for rocks situated in the proximity of intrusive bodies and it occurs in two rock type. The PT conditions of 635 °C and 5 kbar were obtained in rocks with mineral association Grt + Bi + Sill +Cor ± Mu. The origin of this mineral assemblage was probably mediated by the reaction Grt + Sill + Q + H2O = Cor. The other typical association, Bi + Sill +Cor + Kfs ± Grt, corresponds to a temperature of 680 °C and pressure of 5.5 kbar.

Metapelites characterized by mineral association Bi + Sill + + Grt + Kfs are present in the neighbourhood of cordierite-bearing gneisses. These rocks indicate a temperature of 693 °C and pressure of 6.9 kbar. Chemical zoning of garnet is indistinct, corresponding to diffusion zoning, and typical of the growth of garnet in amphibolite-facies conditions. As a result, garnet grain margins probably do not reflect the peak metamorphic conditions.

Metapelites with mineral assemblage Bi + St + Grt + Pl + + Sill (Ky) ± Ms represent another rock type, indicating PT conditions of 659 °C and 9.7 kbar. Garnet and kyanite were produced by reaction St + Ms + Q = Ky + Grt + Bi + H2O. Fibrolithic sillimanite originated later as a product of retrogressive changes of kyanite.

Conclusions

The data obtained from the ZCC allow to estimate part of the PT trajectory for these units. The rocks with mineral assemblage Bi + St + Grt + Pl + Sill (Ky) ± Ms preserved conditions close to the peak metamorphic conditions, i.e., around 660 °C and 10 kbar. During the subsequent exhumation, the pressure dropped and temperature increased to reach the conditions of a temperature maximum >700 °C at c. 7 kbar. The emplacement of tonalite-granite magma later decelerated the decrease in temperature. The conditions of this contact metamorphism were estimated at 5 to 6 kbar and 600 to 700 °C. Conditions of the formation of similar rocks in the northern part of the PCC were different – 565 °C and 2,5 to 3 kbar for cordierite-bearing rocks. This implies that the magma was emplaced at a much smaller depth in the PCC.

References

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