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THERMOBAROMETRY INVOLVING CORDIERITE IN HIGH-GRADE METAPELITES FROM THE SAUWALD, SOUTHERN BOHEMIAN MASSIF

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The Sauwald area is located in the southern rim of the Bohemian Massif and contains migmatites and high-grade metapelitic and granitic gneisses. These rocks were metamorphosed during the post-collisional high T/low P stage of the Variscan metamorphic event (~330 Ma). The metapelitic samples were taken from two localities near Kößldorf and Pyret in Upper Austria. The investigated samples contain the mineral assemblage garnet + cordierite + spinel + sillimanite + K-feldspar + quartz + biotite + muscovite + magnetite + graphite. The peak metamorphic assemblage is: garnet + cordierite + spinel + sillimanite + K-feldspar + quartz.

The P-T conditions of the assemblage garnet + cordierite + spinel + sillimanite + quartz were calculated with the thermobarometry of [1] and this yields pressures ranging from 2.9–5.3 kbar and temperatures of 752–764°C for calculations in the systems FAS and FASH. (2.) Application of the inverse equilibrium approach by [2] yields pressures of 2.8–3.9 kbar and temperatures 645–814°C. Latter calculations were performed with dry cordierite and thus only provide limiting P-T estimates. Thermobarometric calculations involving THERMOCALC [3] yield P-T results ranging from 768°C/4.5 kbars (a_{H2O} = 1.0) to 764°C/3.8 kbars (a_{H2O} = 0.5) to 723°C/2.9 kbar (a_{CO2} = 1.0). These results show that informations about the fluid-content of the cordierites is necessary. Current investigations with microraman spectroscopy at the Institute of Mineralogy and Petrology at the University of Graz yields clear evidence for considerable H_2O and CO_2 contents in the core and the rim of cordierite porphyroblasts, thus indicating that calculations involving high $a_{(H2O)}$ might not yield correct P-T estimates.

An important part of the evaluation of the P-T-$a_{(H2O)}$ conditions of these high-grade metapelites is the application of additional thermobarometric techniques involving cordierite. In recent years, an extensive evaluation of cordierite as a petrogenetic indicator in high-grade metapelites was performed [4, 5]. These studies focused on the incorporation of sodium in cordierite as a function of temperature, pressure and $a_{(H2O)}$. [6] and [5] found an inverse correlation between the sodium content and temperature, allowing a potential application of this relation as a thermometer. Their study also showed that the incorporation of sodium into cordierite is virtually pressure-independent. [5] and [7] showed that the sodium content of cordierite is also a monitor of the presence of fluid or melt in metapelitic rocks. Therefore, the sodium content of cordierites may also serve as a monitor for $a_{(H2O)}$ in the rocks.

Our data indicate temperatures of ca. 650–700°C for the cordierite cores in the presence of a fluid phase in an $a_{(H2O)}$ range of 0.5 to 1.0. The Na content of cordierite in the presence of melt would indicate temperatures exceeding 850°C! The frequently observed assemblage cordierite + garnet in migmatites can also be used as a geobarometer based on the divariant reaction - (Mg, Fe)-cordierite ⇔ (Mg, Fe)-garnet + aluminiumsilicate + quartz + H_2O (MIRWALD & KNOP, 1995). Using the Mg# of the garnet and cordierite cores yields pressures of ca. 4 kbar for temperatures of 750°C. These data provide important independent P-T estimates in addition to thermobarometric estimates based on multi-equilibrium methods and are in good agreement with the P-T results of [8] which yielded P-T conditions of 780°C and 3.8 kbar.

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