MITT.ÖSTERR.MINER.GES. 149 (2004)

CO_2 AND H_2O IN CORDIERITE FROM THIN-SECTIONS: A RAMAN-SPECTROSCOPIC APPROACH

Kaindl, R.[1], Tropper, P.[2] & Bertoldi, C.[3]

[1] Institute of Earth Science (Universitätsplatz 2, A-8010 Graz, Austria)
[2] Institute of Mineralogy and Petrography (Innrain 52, A-6020 Innsbruck, Austria)
[3] Faculty of Geography, Geology and Mineralogy (Hellbrunnerstr. 54, A-5020 Salzburg, Austria)
e-mail: reinhard.kaindl@uni-graz.at; tropper@uibk.ac.at; christian.bertoldi@sbg.ac.at

Cordierite is a common metamorphic mineral in aluminous, medium- to high-grade crustal rocks. In equilibrium with other Fe-Mg-silicates, cordierite changes its Fe-Mg-ratio comprehensible with temperature and may therefore be used as geothermometer in e.g. granulite-facies rocks (DEIBL et al., 2003a). However, molecular CO_2 and H_2O can be incorporated in the channels and cavities of cordierite, greatly influencing its stability field and distorting the geothermometric calculations. CO_2 and H_2O in natural Mg- and Fe-rich cordierite single crystals were previously studied and quantified by combined Raman and IR-spectroscopy (e.g. KOLESOV & GEIGER, 2000). In this study, we tried to estimate the CO_2 and H_2O content of natural Mg-rich cordierite in a thin section from a granulite-facies metapelite (Grt + Sp + Crd + Sill + Bt + Fsp + Qtz) from the Sauwald (Southern Bohemian Massif). The *P-T* conditions of this rock were determined to be 750 – 800 °C and 4 – 6 GPa (DEIBL et al., 2003b).
Spectra were obtained by a JOBIN-YVON™ LabRAM-HR800 Raman spectrometer, a He-Ne 633nm laser and an OLYMPUS™ 100x objective (n.a. 0.9). The laser spot on the surface had a diameter of approx. 1µm. All spectra were recorded at parallel orientation of the incident laser beam and the scattered light. Nine natural and synthetic cordierite single-crystals of known CO_2- and H_2O-concentration (colorimetric titration; BERTOLDI et al., 2004) were measured for calibration purposes. The x-axes of the single crystals were oriented parallel to the polarization of the incident laser beam and the x-parallel CO_2-molecule in the structure. Fitting of relative intensity ratios of the CO_2 stretching mode at 1383 cm^{-1} and two cordierite lattice vibration modes at 973 and 1185 cm^{-1} against CO_2-concentration resulted in a linear calibration curve. This curve can be used to calculate the CO_2-content with a precision around 0.1wt%. It was applied to a natural cordierite of 600 µm diameter in an uncovered thin-section from the Sauwald. The x-axis of the grain laid approximately in the thin-section plane and was oriented parallel to the polarization of the incident laser beam. Fifteen spots across the grain were measured, showing a complex variation in CO_2-content from core to rim. A non-linear relation between H_2O intensity ratios and concentration indicate complex orientation and bonding of the H_2O-molecule in cordierite and prevented quantification.
Polarized micro Raman spectroscopy of cordierite in thin sections provides information about CO_2-content down to 0.1wt% at a spatial resolution of about 2 μm^3 Further research is necessary for the Raman-spectroscopic determination of the H_2O-content.

References

BERTOLDI, C., PROYER, A., GARBE-SCHÖNBERG, D., BEHRENS, H. & DACHS, E. (2004): Lithos, subm.
DEIBL, I., TROPPER, P., MIRWALD, P. & FINGER, F. (2003a): J. Czech Geol. Soc., **48**: 40-41.
DEIBL, I., TROPPER, P., KAINDL, R. & MIRWALD, P. (2003b): Mitt. Österr. Mineral. Ges., **148**: 117-118.
KOLESOV, B.A. & GEIGER, C.A. (2000): Am. Mineral., **85**: 1265-1274.