RAMAN-SPECTROSCOPY OF CORDIERITES FROM Na-IN-CORDIERITE EXPERIMENTS: CHEMICAL VS. STRUCTURAL EQUILIBRIUM

Tropper, P.[1], Haefeker, U.[1] & Wyhlidal, S.[2]

[1]Institute of Mineralogy and Petrography, University of Innsbruck, Innrain 52f, A-6020 Innsbruck, Austria
[2]AIT, Austrian Institute of Technology, A-2444 Seibersdorf, Austria
e-mail: peter.tropper@uibk.ac.at

WYHLIDAL et al. (2008) investigated the Na-incorporation in cordierite in natural samples using two different quartzphyllites (SP: Na, Si-rich; W: Na, Si-poor). The experiments were performed in a hydrothermal apparatus as well as a piston-cylinder apparatus. In order to provide estimates on the degree of equilibration in the experiments, structural investigations such as Raman-spectroscopy and chemical constraints from compositional reversals and pseudosection calculations were performed on samples from both experimental series.

Structural constraints: In order to provide structural constraints on the degree of structural equilibration in the experiments Raman spectroscopic investigations of newly grown cordierites as a function of temperature were done. Synthetic Mg-cordierite has two structural transitions and transforms from the hexagonal over a modulated state to the orthorhombic structure mainly as a result of Al-Si ordering. The cordierites of the experimental series SP and W show a clear temperature-dependent ordering as indicated by the extent of peak splitting in the 530-600 cm^{-1} region. For instance in SP sample 18 at 550°C peak splitting is the least developed indicating the lowest Al-Si ordering state. The distance between the peaks at 555.5 cm^{-1} and 575 cm^{-1} is 19.5 cm^{-1} and almost no peak splitting is visible. Experiment 17 was synthesized at 730 °C and the sample shows the highest degree of ordering as indicated by the distance between the peaks at 554 cm^{-1} and 576 cm^{-1} of 22 cm^{-1} and the shape of the clearly visible peak splitting. The data show that hydrothermally synthesized cordierites grow initially as the disordered polymorph and thus show temperature-dependent Al-Si ordering.

Compositional constraints: Compositional reversals were run in a first step at 0.3 GPa at 680 °C for 720 h and then in a second step at 580 °C for another 720 h. The results of both starting materials show that the Na contents of cordierite started to re-equilibrate which is shown by the overlap of the Na values which were obtained at 580 °C. Pseudosection calculations were undertaken for both whole-rock compositions in the system KNCFMTiASH using the program THERIAK-DOMINO. The amount of the coexisting fluid phase H_2O taken was assumed to be the LOI. The agreement between the calculated and the observed mineral assemblages in both experimental series is only satisfactory but the onset temperature of melt formation is the same at 680 °C. It is also noteworthy that muscovite is more stable in both sets of experiments than in the calculations. Although this discrepancy is large and varies between 30 °C and 110 °C it could be due to minor F and/or Cl contents in the micas which we did not analyse.

The results of this study indicate that even if theoretical, geothermometric and experimental constraints points towards attainment of chemical equilibrium in the experiments, structural disequilibrium features despite the long run times (>300 h) can still occur.

WYHLIDAL, S., THÖNI, W.F., TROPPER, P., MIRWALD, P. (2008): EMPG XII, Innsbruck Univ. Press, 118.