# Cr-INCORPORATION INTO KYANITE: A HIGH PRESSURE EXPERIMENTAL AND CRYSTALLOGRAPHIC STUDY

Hejny, C. & Konzett, J.

Institut für Mineralogie und Petrographie, Universität Innsbruck, Innrain 52, A-6020 Innsbruck, Austria
e-mail: Juergen.Konzett@uibk.ac.at

Aluminosilicates are amongst the most important rock-forming minerals of the Earth's crust and their phase relations provide important constraints on the P-T conditions of equilibration of aluminosilicate-bearing assemblages. The high-P polymorph kyanite is not only stable under crustal P-T conditions but its stability may extend in appropriate bulk compositions to transition zone and even lower mantle depths (SCHMIDT et al., 1997). The only significant Al-substituent in natural kyanite is Cr with up to 12.9 wt% $Cr_2O_3$ reported from mantle rocks (PIVIN et al., 2011). By analogy with garnet, high pressures stabilize Cr in the kyanite structure which is consistent with the fact that Cr-rich (>1 wt% $Cr_2O_3$) kyanites have only been found so far in high pressure (eclogitic) rocks. High P-T experiments have shown that at 3 GPa/1300 °C up to 25 mol% $Cr_2SiO_5$ (38.0 wt% $Cr_2O_3$) can be incorporated into kyanite (LANGER & SEIFERT, 1973).

The present study was initiated (1) to explore the limits of Cr-incorporation in kyanite assuming that P >3 GPa will stabilize even higher Cr-contents, and (2) to study the site occupancy of Cr and the impact of Cr on the elastic properties of kyanite. Multi-anvil experiments at 7 GPa/1100 °C and 7 GPa/1200 °C in fact yielded Cr-kyanites with 52±1 (n=20) and 67±1 (n=10) mol% $Cr_2SiO_5$, corresponding to averaged $Cr_2O_3$ contents of 43.2 and 52.3 wt%, respectively. After run durations of 168-234 hours, Cr-kyanites formed blocky crystals up to 600 x 400 µm in size with a deep emerald-green color. At 7 GPa/1200 °C kyanite coexists with small amounts of eskolaite-corundum solid solution containing 94 wt% $Cr_2O_3$ and 6 wt% $Al_2O_3$. The unit cell parameters of Cr-kyanite with $X_{Cr2SiO5}$ = 0.67 are as follows $a_0$ = 7.2305(5) Å, $b_0$ = 8.0021(8) Å, $c_0$ = 5.6830(4) Å, $\alpha$ = 90.517(7)°, $\beta$ = 101.007(8)°, $\gamma$ = 106.006(6)°; $V_0$ = 309.59(1) Å$^3$ Due to the larger ionic radius of $^{[VI]}Cr^{3+}$ (0.615 Å) compared to $^{[VI]}Al^{3+}$ (0.535 Å) Cr incorporation into kyanite results in a linear increase in the unit-cell parameters with $a_0^{Cr\text{-}ky}/a_0^{ky}$ = 1.015, $b_0^{Cr\text{-}ky}/b_0^{ky}$ = 1.019, $c_0^{Cr\text{-}ky}/c_0^{ky}$ = 1.020 and $V_0^{Cr\text{-}ky}/V_0^{ky}$ = 1.054.

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