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Chromo-alumino-povondraite, $NaCr_3(Al_4Mg_2)(Si_6O_{18})(BO_3)_3(OH)_3O$, a new mineral species of the tourmaline supergroup

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Abstract

Chromo-alumino-povondraite, $NaCr_3(Al_4Mg_2)(Si_6O_{18})(BO_3)_3(OH)_3O$, is a new mineral of the tourmaline supergroup. It is found in metaquartzites of the Pereval marble quarry (Sludyanka, Lake Baikal, Russia) in association with dravite, oxy-chromium-dravite, oxy-dravite, quartz, calcite, chromphyllite, eskolaite, chromite, uvarovite, chromian phlogopite, and pyroxenes of the diopside-kosmochlor series, Cr-bearing tremolite, Cr-bearing titanite, Cr-bearing rutile, and pyrite.

Crystals are green and transparent with a vitreous luster, and exhibit a pale-green streak and conchoidal fracture. Chromo-alumino-povondraite has a Mohs hardness of approximately 7½, and a calculated density of 3.227 g/cm^3. In plane-polarized light, chromo-alumino-povondraite is pleochroic (*O* = emerald green and *E* = pale yellowish green) and uniaxial negative: $\omega = 1.745(5)$, $\varepsilon = 1.685(5)$. Chromo-alumino-povondraite is rhombohedral, space group *R*3*m*, with the unit-cell parameters $a = 16.0277(2)$, $c = 7.3085(1)$ Å, $V = 1625.93(5)$ Å^3, $Z = 3$. Crystal-chemical analysis resulted in the empirical structural formula:

$$^{X}(Na_{0.87}Ca_{0.07}\square_{0.04}K_{0.02})_{\Sigma 1.00}\ ^{Y}(Cr^{3+}_{2.29}Mg_{0.71})_{\Sigma 3.00}\ ^{Z}(Al_{3.04}Mg_{1.54}Cr^{3+}_{1.18}V^{3+}_{0.22}Fe^{3+}_{0.01})_{\Sigma 6.00}$$
$$[^{T}(Si_{5.96}Al_{0.04})O_{18}]\ (^{B}BO_3)_3\ ^{V}(OH)_3\ ^{W}[O_{0.73}F_{0.25}(OH)_{0.02}]_{\Sigma 1.00}$$

The crystal structure of chromo-alumino-povondraite was refined to an *R*1 index of 1.68% using 1803 unique reflections collected with Mo*K*α X-radiation. Ideally, chromo-alumino-povondraite is related to oxy-dravite and oxy-chromium-dravite by the homovalent substitution $Cr^{3+} \leftrightarrow Al^{3+}$. Tourmaline with chemical compositions classified as chromo-alumino-povondraite can be either Al-dominant or Cr-dominant as a result of the compositional boundaries along the solid solution between Al and Cr^{3+} that are determined at $^{Y+Z}(Cr_{1.5}Al_{5.5})$, corresponding to $Na^{Y}(Cr_{1.5}Al_{1.5})^{Z}(Al_4Mg_2)Si_6O_{18}(BO_3)_3(OH)_3O$, and $^{Y+Z}(Cr_5Al_2)$, corresponding to $Na^{Y}(Cr_3)^{Z}(Cr_2Al_2Mg_2)Si_6O_{18}(BO_3)_3(OH)_3O$.

Keywords: Chromo-alumino-povondraite, tourmaline, new mineral species, electron microprobe, crystal-structure refinement, infrared spectroscopy, optical absorption spectroscopy, Sludyanka, Russia