

## Vanadio-oxy-chromium-dravite, $\text{NaV}_3(\text{Cr}_4\text{Mg}_2)(\text{Si}_6\text{O}_{18})(\text{BO}_3)_3(\text{OH})_3\text{O}$ , a new mineral species of the tourmaline supergroup

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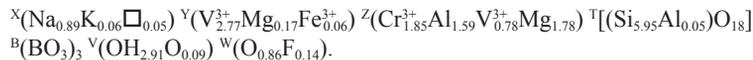
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### ABSTRACT

Vanadio-oxy-chromium-dravite,  $\text{NaV}_3(\text{Cr}_4\text{Mg}_2)(\text{Si}_6\text{O}_{18})(\text{BO}_3)_3(\text{OH})_3\text{O}$ , 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 quartz, Cr-V-bearing tremolite and muscovite-celadonite-chromphyllite-roscoelite, diopside-kosmochlor-natalyite, Cr-bearing goldmanite, esolaite-karelianite, dravite-oxy-vanadium-dravite, V-bearing titanite and rutile, ilmenite, oxyvanite-berdesinskiite, shreyerite, plagioclase, scapolite, zircon, pyrite, and an unnamed oxide of V, Cr, Ti, U, and Nb. Crystals are emerald green, transparent with a vitreous luster, pale green streak, and conchoidal fracture. Vanadio-oxy-chromium-dravite has a Mohs hardness of approximately 7½, and a calculated density of 3.3 g/cm<sup>3</sup>. In plane-polarized light, vanadio-oxy-chromium-dravite is pleochroic (O = dark green, E = pale green) and uniaxial negative:  $\omega = 1.767(5)$ ,  $\varepsilon = 1.710(5)$ . Vanadio-oxy-chromium-dravite is rhombohedral, space group  $R\bar{3}m$ , with the unit-cell parameters  $a = 16.1260(2)$ ,  $c = 7.3759(1)$  Å,  $V = 1661.11(4)$  Å<sup>3</sup>,  $Z = 3$ . Crystal chemistry analysis resulted in the empirical structural formula:



The crystal structure of vanadio-oxy-chromium-dravite was refined to a statistical index  $R1$  of 1.16% using 2543 unique reflections collected with  $\text{MoK}\alpha$  X-radiation. Ideally, vanadio-oxy-chromium-dravite is related to oxy-chromium-dravite and oxy-vanadium-dravite by the homovalent substitution  $\text{V}^{3+} \leftrightarrow \text{Cr}^{3+}$ . Tourmaline with chemical compositions classified as vanadio-oxy-chromium-dravite can be either  $\text{Cr}^{3+}$ -dominant or  $\text{V}^{3+}$ -dominant as a result of the compositional boundaries along the solid solution between  $\text{Cr}^{3+}$  and  $\text{V}^{3+}$  that are determined at  $\text{Y}^{+Z}(\text{V}_3\text{Cr}_2)$ , corresponding to  $\text{Na}^{\text{Y}}(\text{V}_3)^{\text{Z}}(\text{V}_2\text{Cr}_2\text{Mg}_2)\text{Si}_6\text{O}_{18}(\text{BO}_3)_3(\text{OH})_3\text{O}$ , and  $\text{Y}^{+Z}(\text{V}_{1.5}\text{Cr}_{5.5})$ , corresponding to  $\text{Na}^{\text{Y}}(\text{V}_{1.5}\text{Cr}_{1.5})^{\text{Z}}(\text{Cr}_4\text{Mg}_2)\text{Si}_6\text{O}_{18}(\text{BO}_3)_3(\text{OH})_3\text{O}$ .

**Keywords:** Vanadio-oxy-chromium-dravite, tourmaline, new mineral species, crystal-structure refinement, electron microprobe, infrared spectroscopy, optical absorption spectroscopy