

# Crystal chemistry of vanadium-rich garnet from the Sør Rondane Mountains, east Antarctica

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X-ray single-crystal and infra-red spectral studies of vanadium-bearing garnets from the Menipa mountain mass, central part of the Sør Rondane Mountains, East Antarctica (Osanai *et al.* 1990) were carried to determine crystal structures and examine existence of OH-group.

Occurrences of V-bearing garnet are 1) large porphyroblast (type-1); 2) fine crystal (type-2) in kelyphite rim around type-1 garnet; 3) fine-grained porphyroblast (type-3) in matrix.

Chemical compositions of garnets studied in this study are as follows: type-1  $(\text{Ca}_{2.90}\text{Mg}_{0.05}\text{Mn}_{0.02})(\text{Fe}_{0.01}\text{V}_{0.08}\text{Cr}_{0.02}\text{Ti}_{0.03}\text{Al}_{1.86})\text{Si}_{3.02}\text{O}_{12}$ ; type-2  $(\text{Ca}_{2.65}\text{Mg}_{0.12}\text{Mn}_{0.05})(\text{Fe}_{0.21}\text{V}_{0.69}\text{Cr}_{0.18}\text{Ti}_{0.03}\text{Al}_{0.99})\text{Si}_{3.01}\text{O}_{12}$ ; and type-3  $(\text{Ca}_{2.65}\text{Mg}_{0.18}\text{Mn}_{0.07})(\text{Fe}_{0.20}\text{V}_{0.96}\text{Cr}_{0.23}\text{Ti}_{0.03}\text{Al}_{0.68})\text{Si}_{2.98}\text{O}_{12}$ .

The structure refinements of type-1 and type-3 garnets with the space group of *Ia-3d* were reduced with *R*1 of 0.0278 and 0.0689, respectively. The site occupancies determined using both X-ray diffraction data and electron microprobe analysis data are: <sup>VIII</sup>[Ca0.976Mg0.017Mn0.007] and <sup>VI</sup>[Al0.930V0.040 Cr0.01Ti0.015 Fe0.005] for type-1 garnet, and <sup>VIII</sup>[Ca0.885 Mg0.027Mn0.057Fe0.030] and <sup>VI</sup>[Al0.315V0.520Cr0.10 Ti0.015Fe0.05] for type-3 garnet.

Mean interatomic distances are: type-1  $\langle X-O \rangle = 2.407(1)$  Å,  $\langle Y-O \rangle = 1.931(1)$  Å,  $\langle T-O \rangle = 1.651(1)$  Å, and type-3  $\langle X-O \rangle = 2.426(2)$  Å,  $\langle Y-O \rangle = 1.989(2)$  Å,  $\langle T-O \rangle = 1.655(2)$  Å. The increase of  $\langle Y-O \rangle$  distances is caused by the substitution of  $\text{V}^{3+}$  for  $\text{Al}^{3+}$ . By the expansion of the octahedral site with this substitution, the unit-cell parameters increase from  $a = 11.8686(8)$  Å of type-1 garnet to  $a = 11.9694(6)$  Å of type-3 garnet. The mean  $\langle T-O \rangle$  distances of 1.651-1.655 Å are longer than ordinary Si-O distances in silicates.

OH absorptions in the wave number region 3500-3700  $\text{cm}^{-1}$  were confirmed in the infrared spectra of type-1, -2 and -3 garnets.