A natural scandian garnet

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ABSTRACT

Garnet from an aposkarn achtarandite-bearing rodingite-like rock in Sakha-Yakutia, Russia, has a Sc content close to 6 wt% Sc2O3 (~0.45 apfu). The scanda garnet is a relict mineral from a high-temperature, shallow-level melilit skarn. Structural and electron microprobe data for a crystal of the scanda garnet with cell parameter a = 12.331(1) Å, Ia3d allows refinement of the structural formula (C10.39Mg0.02Y0.01)3O12(Fe30.66Zr0.584Ti0.359Fe2+0.294Sc0.153Cr0.152Mg0.094Fe2+0.105H10.002V0.003)2(Si1.896Al0.420Ti0.359Fe0.359)3O12. Investigation of the composition of many of the scanda garnets reveals the existence of a solid-solution between kimzyeite-schorlomite Ca3(Zr,Ti)2(Al,Fe)2Si2O12 and the scandium analog of andradite Ca3Sc2Si3O12. This is the first report of a natural scanda garnet.

INTRODUCTION

Unlike synthetic analogues, natural garnets (general crystal-chemical formula X3Y2Z3O12) are characterized by a limited number of mineral-forming cations: X = Ca, Mg, Mn, Fe; Y = Al, Fe, Cr, Ti, Zr, Mn; Z = Si, which can be partially substituted by Fe and Al (Mandarino and Back 2004). Achtarandite-bearing, rodingite-like aposkarn rocks from the Wiluy River, Sakha-Yakutia (Russia), contain Ti-Zr garnets with scandium contents above 6 wt% Sc2O3, and zirconium contents approaching 25–30 wt% ZrO2. Up to now, maximum Sc2O3 contents ~0.3 wt% Sc2O3 have been reported for spessartine from a Wiluy River, Sakha-Yakutia (Russia), contain Ti-Zr garnets with scandium contents above 6 wt% Sc2O3, and zirconium contents approaching 25–30 wt% ZrO2. Up to now, maximum Sc2O3 contents ~0.3 wt% Sc2O3 have been reported for spessartine from a

RESULTS AND DISCUSSION

Investigations on synthetic scandian pyrope and grossular show that scandium occupies octahedral positions in grossular whereas it occupies the eightfold coordinated position in pyrope (Quartieri et al. 2004). Preliminary results on the solid-solution series between andradite Ca3Fe3+3SiO12 and its scandium analog Ca3Sc2Si3O12 (Ito and Frondel 1968) suggest little deviation from ideal mixing behavior (Woodland and Angel 1996).

In this letter, we provide data on the morphology, composition, and structure of a scanda garnet from Sakha–Yakutia and, in addition, we discuss the genesis of the garnet and the source of the scanda.

ANALYTICAL METHODS

The garnet morphology and composition were investigated using a Philips/FEI XL30/EDAX scanning electron microscope and a CAMECA SX100 electron microprobe analyzer. Compositions were measured at 15 kV and 30 nA using natural and synthetic standards. X-ray maps were recorded at 15 kV, 40 nA. Structural data for a single crystal of scanda garnet were collected using an Enraf-Nonius CAD4 diffractometer (exposure time = 120 s). Cell dimensions were determined from reflections > 23.56° theta. The Raman spectra of the scanda garnet were recorded using a Raman microscope T-64000 (Jobin–Yvon) with a 514.5 nm Ar ion laser. The absence of hydroxyl groups was confirmed by Raman microprobe and FTIR (BioRad, KBr) investigations.

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