

ON THE COMPOSITION OF SOME CANADIAN GREEN GARNETS

PETE J. DUNN

Department of Mineral Sciences, Smithsonian Institution, Washington, D.C. 20560

ABSTRACT

Green garnets from eight Canadian occurrences are described in terms of chemical composition. Chromian grossular occurs at six of the localities and uvarovite occurs at only two: South Ham, Wolfe County, Quebec, and Kootenay, British Columbia. The green chromian grossular from Orford varies in composition from $(Ca_{5.89}Mn_{0.09})(Al_{3.14}Cr_{0.41}Fe^{3+}_{0.37})Si_{6.06}O_{24}$ to $(Ca_{5.89}Mn_{0.11})(Al_{2.54}Cr_{1.25}Fe^{3+}_{0.21})Si_{6.00}O_{24}$. Compositional variation is also observed in chromite inclusions.

SOMMAIRE

Huit grenats verts de localités canadiennes ont été analysés. Dans six de ces localités on trouve des grossulaires chromifères; dans les deux autres, South Ham, comté de Wolfe, Québec et Kootenay, Colombie Britannique, des uvarovites. Le grossulaire chromifère d'Orford, Québec, varie de $(Ca_{5.89}Mn_{0.09})(Al_{3.14}Cr_{0.41}Fe^{3+}_{0.37})Si_{6.06}O_{24}$ à $(Ca_{5.89}Mn_{0.11})(Al_{2.54}Cr_{1.25}Fe^{3+}_{0.21})Si_{6.00}O_{24}$ et contient des inclusions de chromite qui sont aussi de composition variable.

(Traduit par la Rédaction)

INTRODUCTION

The occurrence of green calcian garnets at a large number of Canadian localities has been noted by various authors. The name uvarovite has been loosely, and quite incorrectly, applied to some of these garnets.

The first reported occurrence of green calcian garnet in Canada was by Logan (1863), who described crystals from Orford, Quebec, and gave a chemical analysis indicating an Al:Cr ratio greater than 4:1. However, much to his credit, he did not call these garnets uvarovite. The second occurrence was reported from Lot 29, Range IV, Wakefield Township, Quebec, by Harrington (1881) who gave an analysis of a calcian garnet with an Al:Cr ratio greater than 5:1. The only other reported analysis is that of a green garnet from the Normandie mine, near Thetford, Quebec, by Grubb (1965) who found an Al:Cr ratio greater than 1.27:1. All three analyses indicate that these garnets are chromian grossular [following the accepted no-

menclature conventions of Schaller (1930)] and not uvarovite.

NEW ANALYSES

The present study was initiated to analyze a large number of Orford samples to establish the presence or absence of uvarovite, to give compositional data for other Canadian green garnets, and to examine the Orford green grossular for the presence of any unusually large amounts of nickel due to the associated maucherite.

The samples were analyzed using an ARL-SEMQ electron microprobe using an operating voltage of 15 kV and an aperture current from a beam current monitor of 0.15 μ A. The data were corrected for background effects, backscatter, absorption and absorption using Bence-Albee factors. The standard used for the chromite analyses was an analyzed chromite. The standards for the garnet analyses were: chromite for chromium, manganite for manganese, a magnesian ferrian grossular for aluminum and silicon, hornblende for iron, magnesium, titanium, potassium and calcium, and NBS stainless steel for nickel. The resultant analyses are given in Table 1. All garnets contain less than 0.05 wt. % NiO.

TABLE 1. MICROPROBE ANALYSES OF SOME CANADIAN GREEN GARNETS

	1	2	3	4	5	6	7	8	9	10
SiO ₂	38.70	39.89	39.00	38.81	39.84	39.73	39.17	39.21	37.41	36.25
TiO ₂	0.00	0.00	0.00	0.50	0.42	0.13	0.11	0.31	0.34	1.07
Al ₂ O ₃	13.90	17.56	14.35	17.04	17.75	17.87	16.05	21.19	9.29	3.76
Cr ₂ O ₃	10.18	3.45	9.08	4.75	3.37	4.64	6.35	0.71	15.69	22.57
Fe ₂ O ₃ *	1.80	3.27	1.89	1.27	2.96	0.66	2.51	1.00	1.68	1.03
FeO**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.98	0.00
MgO	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.38	0.34
MnO	0.80	0.68	0.40	0.11	0.74	0.83	1.10	1.03	0.54	0.80
CaO	35.42	36.20	35.87	37.22	36.11	36.06	35.24	36.88	32.58	34.28
Total	100.80	101.05	100.59	99.78	101.19	99.92	100.53	100.33	99.89	100.10

* total iron calculated as Fe₂O₃; ** total iron allotted to FeO and Fe₂O₃ to satisfy stoichiometry. Accuracy of microprobe data \pm 3% of amount present.

1) National Museum of Natural History, Smithsonian Institution (NMNH) 80964, Orford, Que. 2) NMNH 117006, Orford, Que. 3) NMNH 119232, Wakefield Twp., Que. 4) Geological Survey of Canada (GSC) 14672, Lot 29, Range IV, Wakefield Twp., Que. 5) NMNH 117007, Brompton Lake, Que. 6) NMNH R11362, Thetford, Que. 7) NMNH R15086, Magog, Que. 8) GSC 14337, Jeffrey mine, Asbestos, Richmond Co., Que. 9) GSC 14671, Southern end, west side, Upper Arrow Lake, West Kootenay District, B. C. 10) GSC 6522, South Ham, Wolfe Co., Que.

DISCUSSION

Fourteen specimens from Orford were analyzed. Two of the analyses are given in Table 1 and represent the maximum and minimum determined chromium content. None of the fourteen specimens that were analyzed are uvarovite; all are chromian or ferrian grossular. The analyses suggest a continuum in chromium substitution for aluminum between $(\text{Ca}_{5.89}\text{Mn}_{0.09})\text{-}(\text{Al}_{3.14}\text{Cr}_{0.41}\text{Fe}^{3+}_{0.37})\text{Si}_{16.06}\text{O}_{24}$ and $(\text{Ca}_{5.89}\text{Mn}_{0.11})\text{-}(\text{Al}_{2.54}\text{Cr}_{1.25}\text{Fe}^{3+}_{0.21})\text{Si}_{16.06}\text{O}_{24}$.

In addition, ten chromites, present as inclusions in the Orford chromian grossular, were also analyzed. Their compositions vary from $(\text{Cr}_{1.57}\text{Al}_{0.37}\text{Fe}^{3+}_{0.08})(\text{Fe}^{2+}_{0.57}\text{Mg}_{0.40}\text{Mn}_{0.02})\text{O}_4$ to $(\text{Cr}_{1.72}\text{Al}_{0.23}\text{Fe}^{3+}_{0.08})(\text{Fe}^{2+}_{0.53}\text{Mg}_{0.43}\text{Mn}_{0.02})\text{O}_4$, on the basis of four oxygen atoms.

Garnet samples from seven other localities were also analyzed. Five of these garnets are chromian grossular; two are uvarovite ($\text{Cr} > \text{Al}$), from the two known localities of this garnet in Canada: South Ham, Wolfe County, Quebec, and Upper Arrow Lake, West Kootenay District, British Columbia. The analyzed sample from South Ham, kept in the Geological Survey of Canada collection (GSC 6522), has a reflective index of 1.83(1) measured in sodium light and a unit-cell edge $a = 11.97(1)\text{\AA}$.

What may be a new nickel silicate mineral was found as very small grains ($3\text{-}4\mu\text{m}$) in the Orford specimens. It occurs only rarely at the border between grains of chromian grossular and the intimately associated maucherite. There was too little of the mineral to permit its characterization at this time. The associated maucherite was partially analyzed and found to be almost pure $\text{Ni}_{11}\text{As}_8$, with no iron substituting for nickel.

In summary, most Canadian green garnets examined are chromian grossular; this finding contrasts with report of Traill (1970, 1974)

who lists most of these occurrences under uvarovite. South Ham, Wolfe County, Quebec, and Upper Arrow Lake, West Kootenay District, British Columbia provide Canadian localities for uvarovite.

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