NOTE ON MINOR ELEMENTS IN GARNETS

BY

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Abstract. Semiquantitative spectrochemical determinations on material mainly from the Akershus-Östfold gneiss area show that V is more abundant in garnets from amphibolite than in garnets from gneiss. Both V and Cr are more abundant in biotite and hornblende than in the associated garnet. In garnets from granitic and pegmatitic rocks, V and Cr are extremely low, while Y and Y-earth elements may be quite high; garnets from some of the gneiss specimens show similar minor element associations. In an eclogite specimen, V and Ni are strongly enriched in the pyroxene, while Cr is more equally distributed between garnet and pyroxene.

Spectrochemical work on mainly rockforming garnets, in progress at our Institute of Geology several years ago, was interrupted in favour of other investigations and remained unfinished. However, some of the results obtained may deserve publication.

Preliminary spectrograms of a number of garnets showed that determination of V, Cr, Y, and Yb might be worthwhile. A garnet which had been found to be nearly free of these elements was used as the base substance of the standard mixtures, which were made to contain known percentages of V_2O_5, Cr_2O_3, Y_2O_3, and Yb_2O_3, the last being a spectrochemically convenient representative of the yttrium earths. The standard mixtures as well as the mineral samples were all mixed with a fixed amount of NaCl prior to arcing, and a virtually constant general intensity level of the spectrograms was attained. Attempts were made to introduce a special internal intensity standard, but these were not very successful. Then it was decided to use Fe-lines as intensity standards. Although most of the examined garnets were almandines, this procedure is not really satisfactory. I suppose that some of the determinations may be in error by as much as $\pm$ 50%.

Table 1.

Minor elements in garnets, ppm

Origins of samples	V	Cr	Y + Yb
1. Gneiss Akershus–Östfold	400	—	—
2. – –	200	tr	—
3. – –	100	50	—
4. – –	tr	50	—
5. – –	tr	50	—
6. – –	50	100	—
7. – –	50	—	tr
8. – –	200	—	100
9. – –	100	100	100
10. – –	50	tr	300
11. – –	tr	tr	300
12. Amphibolite –	300	—	—
13. – –	300	tr	—
14. – –	200	tr	—
15. – –	200	50	tr
16. – Near Risör	100	100	tr
Garnets from gneiss. Average	100	40	70
Garnets from amphibolite. Average	200	40	—
17. Granitic dike, Tördal, Telemark	—	—	200
18. Aplite dike – –	—	—	150
19. Granite pegmatite –	—	—	1,500
20. – –	—	—	800

Most of the material was collected along roads in part of the Akershus—Östfold gneiss area. Garnets, and in a number of cases also biotite and hornblende, were separated from the rocks by means of a magnetic separator and heavy liquids, and very pure fractions were obtained. The lines used for intensity readings were V 3184, Cr 4254, Y 3242, Yb 3289. Significant results are shown in Tables 1 and 2. Concentrations lower than 50 ppm are not recorded in the Tables; when observed at all, they have been designated by 'tr'.

Table 2.

Distribution of V and Cr between co-existing minerals in some of the specimens listed in Table 1

	Garnet		Biotite		Hornblende	
	V	Cr	V	Cr	V	Cr
1. Gneiss.......	400	—	1,000	—		
10. –	50	tr	400	100		
4. –	tr	50	400	200		
7. –	50	—	300	—		
5. –	tr	50	200	100		
11. –	tr	tr	200	100		
3. –	100	50	100	200		
12. Amphibolite .	300	—	200	—	1,000	50
15. – .	200	50	300	200	600	300
16. – .	100	100	200	200	400	100

Appendix: Eclogite, Möre	Garnet			Pyroxene		
	V	Cr	Ni	V	Cr	Ni
	100	20,000	tr	1,000	10,000	500

Comments on the results

Vanadium appears to occur more abundantly and regularly in garnets from amphibolite than in garnets from gneiss. This clearly reflects the different V-abundances of the two rock types: it is well known that V is a common minor element in ferromagnesian minerals. Table 2 shows that biotite and hornblende are in general richer in V than the associated garnet. Similarly, in the examined eclogite specimen, the pyroxene is much richer in V than the garnet. The examined garnets (Mn-rich) from granitic and pegmatitic rocks do not contain detectable V. The contents of *chromium* in garnets from gneiss and amphibolite are generally low but with local maxima. In biotites and hornblendes the Cr-contents are considerably higher and run approximately parallel to those of the associated garnets. In garnets from granitic and pegmatitic rocks no Cr was found. The eclogite is very rich in Cr, which is here fairly equally distributed between garnet and pyroxene. The eclogite is also rich in *nickel*, nearly all of which is found in the pyroxene. This must be due to the different environments of Mg in the two crystal structures, since Ni is supposed to replace Mg here as in olivine. These observations on the distribution of Cr and Ni in eclogite are in full agreement with the findings of TUREKIAN (1963) in a number of other eclogites. *Yttrium* and *yttrium earth elements* occur rather abundantly in garnets from granitic and pegmatitic rocks. These elements are also found in garnets from a few of the examined gneiss specimens and may then indicate a partially granitic or pegmatitic origin of these gneisses.

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REFERENCE

TUREKIAN, K. K. 1963. The chromium and nickel distribution in basaltic rocks and eclogites. *Geochim. et Cosmochim. Acta 27*, 835–46.

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