tetrahedral interstices in the framework of close-packed oxygens. Further work is in progress to determine the detailed cation distribution.

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Re-examination of pyrope from the Stockdale kimberlite, Riley County, Kansas

BAGROWSKI (1941) has reported the presence of pyrope in the Stockdale kimberlite pipe (39° 15′ 40″ N., 96° 42′ 8″ W.), twenty miles northwest of Manhattan, Riley County, Kansas. The identification was based on a chemical analysis the results of which are shown in table I. The striking feature of this analysis is the high percentage of Cr_2O_3 (7·90 %) reported, and the Stockdale pyrope has been subsequently cited in the literature as an example of chromium-rich pyrope (Deer, Howie, and Zussman, 1962, vol. 1, pp. 98 and 99; Tröger, 1959, No. 162, p. 32; and others). Based on this analysis Tröger (1959) presented an end-member composition of the pyrope as: pyrope 59·8, almandine 27·9, spessartine 0·00, grossular 3·1, andradite 0·0, and uvarovite 9·2 %.

This note is not intended to refute the identification of the Stockdale garnet as pyrope, as Eastwood and Brookins (1965) and Rosa (1966) have demonstrated by X-ray diffraction that pyrope is indeed the species present. However, the following points should be considered: according to the data reported by Bagrowski (1941) shown in table I, there are too many trivalent cations relative to divalent cations to allow a garnet formula to be calculated (even though the analysis does sum to 99·07 wt. %); according to the work of Nixon *et al.* (1963, fig. 7, p. 1106) a kimberlitic pyrope containing 7·90 % Cr_2O_3 should have a refractive index near 1·759 as opposed to the reported value of 1·746 (Bagrowski, 1941); in addition, Rosa (1966) determined the refractive index and unit cell for the garnet (see table I) and presented an end-member composition of pyrope 75, almandine-andradite 25 % based on the diagrams of n vs. a of Sriramadas (1957).

Because of these apparent discrepancies and as part of a long-range

study of kimberlites, the Stockdale pyrope has been re-examined. Petrographic and X-ray studies were performed at Kansas State University, and a commercial chemical analysis was obtained (table I).

TABLE I. Chemical data for Stockdale pyrope: wt. % and atoms per 12 oxygens, after deduction of $CaCO_3$ from (1)

	1	2		1		2	
SiO_2	41·11	40·42	Si	2·98	3·01	3	3
TiO_2	0·27	—	Ti	0·03		—	
Al_2O_3	21·50	21·12	Al	1·76	2·00	1·84	2·86
Fe_2O_3	1·37	10·50	Fe‴	0·08		0·58	
Cr_2O_3	2·77	7·90	Cr	0·14		0·44	
FeO	7·55	—	Fe″	0·46	2·99	—	1·97
MgO	20·57	14·42	Mg	2·22		1·59	
CaO	4·64	4·71	Ca	0·29		0·38	
MnO	0·37	—	Mn	0·02		—	
Sum	100·61	99·07					

1. Red Stockdale pyrope; anal. H. Asari, Japan Analytical Chemistry Research Institute, Tokyo; also Na_2O 0·14, K_2O 0·07, P_2O_5 0·02, CO_2 0·06, SO_3 0·01, H_2O^+ 0·12, H_2O^- 0·04 %.

2. Stockdale pyrope, after Bagrowski, 1941; anal. Kansas Geological Survey.

Description and procedures. A typical pyrope from the Stockdale kimberlite pipe is characteristically highly fractured and surrounded by a kelyphitic rim of chrysotile, with or without minor amounts of other minerals. The kelyphitic rim is often partially or completely removed due to conditions of churning and brecciation that accompanied emplacement. The fractures within the grains are commonly filled with carbonate minerals, usually calcite.

The pyrope grades from deep blood red to emerald green in colour, with all intermediate colour variations. In general, each grain is characterized by one distinct colour, but colour zoning probably exists. According to Smirnov (1959) this colour variation may indicate a range in conditions of temperature and pressure during crystallization. For the present study, only the deep red variety was investigated by petrographic and chemical methods because it is abundant and best duplicates the (presumed) material on which Bagrowski (1941) worked. The pyrope was separated by hand picking and then treated with 0·5 *N* acetic acid to remove the carbonate minerals. This step was monitored by scanning for carbonate mineral peaks on an X-ray diffractogram on the treated sample, and the acid treatment was repeated until the carbonates were completely removed. A dark green pyrope aliquot was also separated for optical and X-ray studies, but sufficient quantities could not be obtained for chemical work.

Results and conclusions. A new chemical analysis and optical and X-ray data for red pyrope from the Stockdale kimberlite pipe are presented in table I. The following steps have been taken prior to calculating the R^{2+} and R^{3+} (based on a total of 12 oxygen atoms) contents: the CaO content was corrected for the CO_2 present; the small amounts of K_2O, Na_2O, P_2O_5, H_2O (+), and SO_3 present have been ignored as they are no doubt present in minor inclusions which the acid treatment did not remove. The writer believes that these impurities are due to the presence of small amounts of kelyphite attached to the garnets. If true, then the amounts of SiO_2, MgO, etc., actually present within the pyrope structure will be lowered by a slight amount; but the uncertainty introduced into the results calculated in table I will only amount to $\pm 0{\cdot}01$ atom per 12 oxygen.

The new Cr_2O_3 analysis of 2·77 % is consistent with n 1·747 (Nixon *et al.*, 1963), and it must be concluded that the 7·90 % of Cr_2O_3 reported by Bagrowski (1941) is in error. This conclusion is further borne out by the facts that the ratio of R^{2+}/R^{3+} for the 1941 analysis is wrong and that Rosa's (1966) n vs. a data do not indicate the presence of the uvarovite molecule.

The optical and X-ray data for green pyrope from the Stockdale kimberlite indicate that it may be even more chromium-rich, and this material will be investigated in the future.

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