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NICKEL MINERALS FROM BARBERTON, SOUTH AFRICA: V. TREVORITE, REDESCRIBED

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ABSTRACT

Trevorite from the well-known nickel occurrence in the Bon Accord area, Barberton, is redescribed. The mineral is the major constituent of the assemblage trevorite–nickel olivine–nickel serpentine–nickel chlorite.

The trevorite has 7.703 nickel ions per 32 oxygen ions in the unit cell, a cell edge of 8.339 (1) Å, a reflectivity of 24 percent at 589 nm, a Vickers hardness of 917 kg/mm^2 with 100mg load, and a measured specific gravity of 5.332 (15).

INTRODUCTION

Further investigation of rock samples from the nickel occurrence two miles west of the Scotia Talc Mine, Bon Accord, Barberton, revealed the existence of yet another mineral assemblage, entirely different from the one described earlier by de Waal (1969, 1970a, 1970b). The newly found assemblage consists primarily of trevorite–nickel olivine–nickel serpentine–nickel chlorite, as well as a few minor minerals as yet unidentified.

Trevorite was first reported from the same area by Walker (1923), and described by Partridge (1944). However, much information can be added to these initial descriptions, and many of the values given by Partridge appear to be inaccurate.

This paper deals with the mineragraphy of the trevorite and compares the physical and optical properties of the minerals in the magnetite–trevorite series.

The new values for hardness and reflectivity should aid in the identification of tiny trevorite grains.

EXPERIMENTAL METHODS

Microscopy formed the basis of the approach in this present study. The colors allotted macroscopically are in accordance with the Rock-Color Chart, issued by the Geological Society of America.

The trevorite was purified in the following manner: The material was ground to between 150 and 200 mesh (Tyler), and elutriated to remove part of the silicate impurities. The resulting trevorite concentrate was boiled in a 50 percent (by weight) H_2SO_4 solution for one minute. It was then scrubbed mechanically, and elutriated to remove silicates. The scrubbing and elutriating were repeated several times.

The specific gravity was determined in toluene in a temperature-controlled room at 21.5(5)°C. The specific gravity of the trevorite was also calculated according to the proposals of Schlecht (1944).

The Leitz Miniload Hardness Tester was used to determine the Vickers microhardness of the minerals. The graph of Young and Millman (1962) was used to derive the macrohardness (Moh's) from the microhardness.

Reflectivity measurements were made on freshly polished surfaces with a Leitz microphotometer. Leitz standards, as well as a silicon carbide standard calibrated by Zeiss, were used in the determinations.

The X-ray diffraction analyses were made with both a Debye-Scherrer camera (114.6mm diameter) and a diffractometer. Corrections were made for film shrinkage.

Results and Discussion

The optical and physical properties of trevorite appear in Table 1 and chemical data on the mineral are contained in Table 2.

TABLE 1

Optical and physical properties of trevorite compared with those of ferroan trevorite and magnetite

Property	Trevorite	Ferroan trevorite*	Magnetite
Colour and lustre	Black, metallic, dusky brown (5 YR 2/2) when finely powdered	Black, metallic	
Specific gravity	5.332 ±0.015 (measured) 5.349 (calculated)	5.212 ±0.007 (measured) 5.227 (calculated)	5.196 (calculated)
	Sp.gr. for $NiFe_2O_4$=5.369		
Hardness	Vickers microhardness (HV)	HV	HV
	1062 ±50 kg/mm^2 with 15mg load	-	-
	937 ±10 kg/mm^2 with 50mg load	798 kg/mm^2 with 50mg load	-
	917 ±13 kg/mm^2 with 100mg load	773 kg/mm^2 with 100mg load	490 to 660 kg/mm^2 with 100mg load†
	Macrohardness (Mohs):	Macrohardness (Mohs):	Macrohardness (Mohs):
	6-6½ (derived from HV)	5½-6 (derived from HV)	5-5½ (derived from HV)
Reflectivity	24.1% at 548nm	21.0% at 548nm	20.8% at 546nm§
	24.0% at 589nm	20.8% at 589nm	21.0% at 589nm
Cell edge	8.339 ±0.001Å at 23.5°C	8.367 ±0.003Å	8.396÷
Ni-ions per 32(O) in unit cell	7.703	4.156	Approx.0

* De Waal (1969)

† Young and Millman (1962)

§ Uytenbogaardt and Burke (1971)

÷ Deer, Howie, and Zussman (1962)

TABLE 2

Chemical data for trevorite

Element oxide	%	Number of cations on the basis of 32(O)		
SiO_2	0.36	Si	0.113	
Cr_2O_3	0.37	Cr	0.092	16.001
Al_2O_3	0.22	Al	0.082	
Fe_2O_3	66.33	Fe^{3+}	15.714	
MnO	0.04	Mn	0.011	
MgO	0.03	Mg	0.014	8.056
CoO	0.43	Co	0.109	
NiO	30.42	Ni	7.703	
CaO	0.65	Ca	0.219	
Total	98.85			

Analysis by the Analytical Chemistry Division, NIM.

The most important facts are:

(1) The specific gravity of the trevorite is much higher than the value of 5.26 previously reported in Deer *et al.* (1962).
(2) The cell edge value is identical with that of 8.339 reported for synthetic nickel ferrite in the ASTM index.[1]
(3) The Vickers hardness provides a rapid means of identification of the members of the trevorite–magnetite series. This could be a valuable method in the study of nickeliferous serpentinites.
(4) Reflectivity measurements may also help in the identification of trevorite.
(5) The cell-edge values of the members of the trevorite–magnetite series have a straight-line relationship with the number of nickel ions in the unit cells. This relationship provides an accurate means of identification of the members of the trevorite–magnetite series.
(6) The specific gravity is difficult to determine accurately, and therefore remains less reliable as an indicator of the nickel content of the members of the trevorite–magnetite series.

[1] Inorganic index to the powder diffraction file. Joint Committee on Powder Diffraction Standards. Philadelphia, 1970, Card no. 10-325.

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HOLLANDITE-CORONADITE IN FOSSIL BONE

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ABSTRACT

Manganese is a widespread minor element in fossil bone. We have identified the manganese-containing mineral as a member of the hollandite group. Precipitation of the hollandite minerals is catalyzed by the presence of citric and butyric acid in bone.