GEIKIELITE, A NEW CANADIAN OCCURRENCE

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ABSTRACT

A new occurrence of geikielite is in magnesian marble near Wakefield, Quebec. Crystals are rounded, anhedral to subhedral, up to 20 mm. The analysis of a large crystal gave $(Mg_{0.77}Fe_{0.15}^{2+}Fe_{0.10}^{3+}Mn_{0.02})_{1.04}Ti_{0.96}O_{3.00}$. Weissenberg and precession photographs indicated $a_H = 5.055$, $c_H = 13.907$, and space group $R\bar{3}$. S. G. measured = 4.05, S. G. calculated = 4.14. Polished sections reveal the presence of several sets of thin lamellae, presumably twinning.

INTRODUCTION

Geikielite, the magnesium end member of the ilmenite series, has been identified in material collected from the Maxwell brucite quarry in the vicinity of Wakefield, Quebec, about 20 miles north of Ottawa (Fig. 1). To the best of our knowledge this is the first occurrence reported in Canada.

Other known geikielite occurrences may be divided into the following types:

(a) Those not occuring *in situ*, for example the gem gravels of Ceylon (Dick, 1893; Crook & Jones, 1906).

(b) Those associated with chlorite in serpentinized ultra-basic rocks, as in some of the chromium deposits in the USSR, for example Camel Mountains, Southern Urals, (Kashin, 1937) and Mount Jemorakly-Tube, North Caucasus, (Efremov, 1954).

(c) Those occuring in magnesium marbles, for example Riverside, California, (Murdoch & Fahey, 1949) and Santa Lucia Mountains, California, (Wise, 1959). The occurrence described here is of this type.

Geological setting

The rocks near Wakefield are all of Precambrian age and form part of the Grenville province. Small bodies of marble, commonly bearing various combinations of diopside, serpentine and brucite as major constituents are enclosed by the Wakefield syenite. They crop out over an area of about 4 square miles (Fig. 2) and are presumably roof pendants (Ambrose, 1943; Hogarth, 1962).

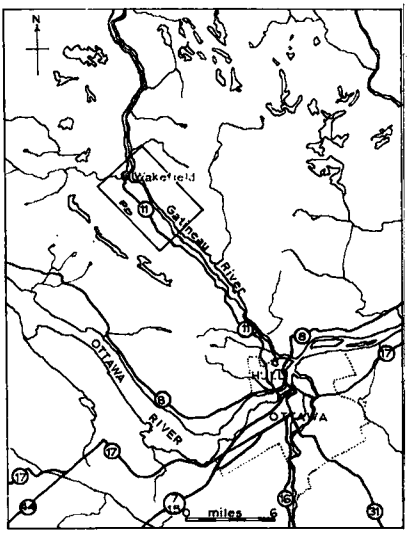

FIG. 1. Location map of Wakefield area.

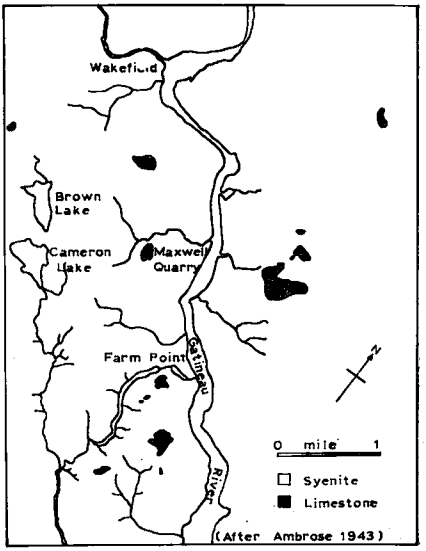

FIG. 2. Wakefield area showing outcrop of marble in Wakefield syenite.

MINERALOGY

Description and association

The geikielite, found only in a small area in the western part of the Maxwell quarry, near the syenite contact, is associated with calcite, serpentine and hydrotalcite. It is black, opaque and occurs as rounded anhedral to subhedral grains of diverse size, varying from a few tenths of a mm to 20 mm.

Optical examination

Polished section examination reveals the presence of several sets of lamellae (Fig. 3) ranging in width from 0.001 to 0.05 mm. These are pleochroic from light grey to pinkish grey. Where two lamellae cross one is frequently offset. The bulk of material between the thin lamellae does not appear to be pleochroic and is intermediate in colour between the extremes shown by the lamellae. All parts of the section are however strongly anisotropic.

The appearance of the lamellae strongly suggests twinning but this was not observed on single crystal photographs. An electron microprobe scan for Ti and Fe was carried out across several lamellae but no discontinuities appeared on either run and thus the possibility of two-phase

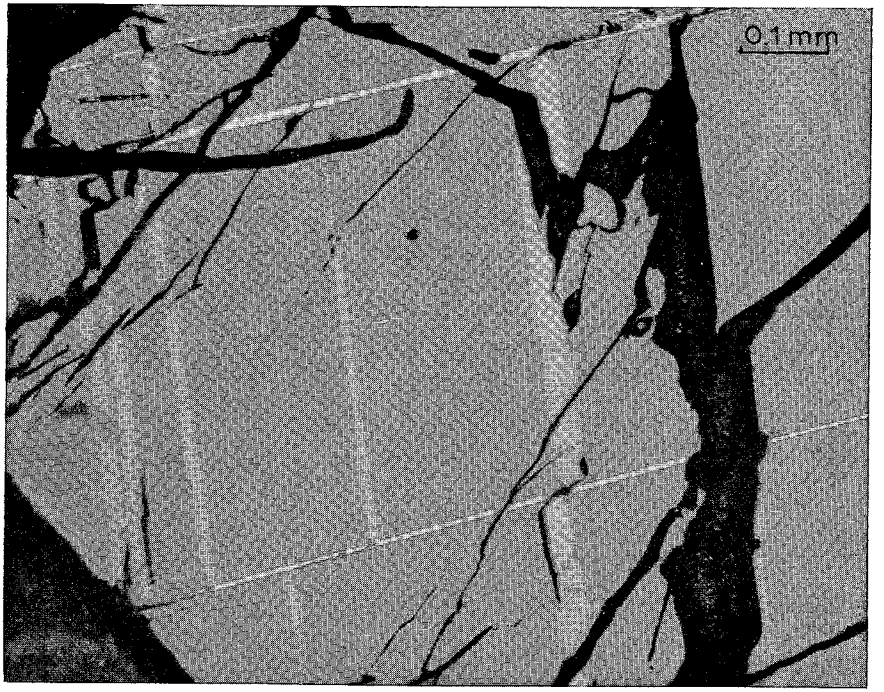

FIG. 3. Polished section of Wakefield geikielite under crossed polarizers showing what is presumed to be twinning.

intergrowths seems to be unlikely. It is more likely that the lamellae are due to twinning but are too small for their diffraction spots to show up on single crystal photographs.

Chemical analysis

One large grain was crushed and cleaned using conventional methods. The sample was fused with potassium pyrosulphate in a platinum crucible and the melt dissolved in dilute sulphuric acid. Titanium, total iron and manganese were determined spectrophotometrically using peroxide, orthophenanthroline and permanganate procedures respectively. Magnesium was determined titrimetrically with E.D.T.A. and ferrous iron by room temperature decomposition of the sample in hydrofluoric acid and ammonium metavanadate followed by back titration with ferrous ammonium sulphate. Ferric iron was determined by difference. Details of these procedures are given in Hounslow & Moore (1966).

The analysis of the Wakefield geikielite and a selection of other analyses from the literature are shown in Table 1. It is apparent that the Crestmore geikielite most nearly approximates to the pure magnesium end member while the material from Wakefield is highest in ferric iron.

TABLE 1. ANALYSES OF MEMBERS OF THE ILMENITE-GEIKIELITE SERIES

	$FeTiO_3$	$MgTiO_3$	(1) Ceylon	(2) Crestmore	(3) USSR	(4) Wakefield
TiO_2	52.66	66.46	63.94	64.9	57.52	60.7
MgO	—	33.54	25.79	31.8	21.57	24.4
FeO	47.34	—	10.09	1.4	12.30	8.4
Fe_2O_3	—	—	0.25	—	2.82	6.2
MnO	—	—	—	0.4	1.27	0.91
Rem.	—	—	—	2.2	4.35	—
Total	100.00	100.00	100.07	100.7	99.83	100.6
S.G.	4.79	4.03	4.01	3.79	4.1	4.05
			Cell content based on 3 oxygens			
Ti	1.00	1.00	1.01	1.00	0.97	0.96
Mg	—	1.00	0.80	0.97	0.72	0.77
Fe^{2+}	1.00	—	0.18	0.02	0.23	0.15
Fe^{3+}	—	—	0.00	—	0.05	0.10
Mn	—	—	—	0.01	0.02	0.02

(1) Crook & Jones, 1906. (2) Murdoch & Fahey, 1949. (3) Efremov, 1954. (4) Analyst, A.W.H.

X-ray examination

Single crystal photographs were taken with precession and Weissenberg cameras. Examination of systematic extinctions indicated a space group of $R\bar{3}$. The hexagonal cell edges were obtained from the 0-level a^*-axis precession photograph (Mo radiation), a-axis rotation and 0-level Weissenberg photographs (Cu radiation). The average values are $a = 5.055 \pm 0.010$, $c = 13.907 \pm 0.018$.

Powder photographs were taken using filtered iron radiation and a 114.6 mm diameter camera. The d-values, corrected for shrinkage, are listed in Table 2 with d-values from A.S.T.M. card 6-0494.

Specific gravity

The specific gravity of Wakefield geikielite, determined with a Berman balance is 4.05, in fair agreement with the value of 4.14 calculated from the analysis and the above cell dimensions.

TABLE 2. POWDER DIFFRACTION DATA FOR GEIKIELITE

	ASTM 6-0494		Wakefield	
*hkl**	*d*	*I*	*d*	*I*
003†	4.64	32	4.64	10
101†	4.18	31	4.18	5
012	3.703	43	3.705	35
104	2.722	100	2.725	100
110	2.527	57	2.528	40
113	2.218	70	2.218	40
202	2.090	10	—	—
024	1.852	40	1.853	30
107	1.809	4	—	—
116	1.708	55	1.709	60
211	1.6434	5	—	—
018	1.6148	12	1.617	5
214	1.4938	29	1.4958	20
027	1.4708	6	—	—
030	1.4592	38	1.4610	20
303	1.3919	2	—	—
208	1.3606	2	—	—
1, 0, 10	1.3247	13	1.3275	10
119	1.3174	8	1.3198	1
217	1.2708	4	—	—
220	1.2634	9	1.2655	3
223	1.2191	4	—	—
131	1.2085	2	—	—
128	1.1978	6	1.1990	3B
0, 2, 10	1.1735	5	1.1760	3
134	1.1462	11	1.1476	5
315	1.1125	10	1.1111	10
226	1.1093	10	—	—
042	1.0809	2	—	—
2, 1, 10	1.0642	13	1.0661	10
1, 1, 12	1.0528	1	—	—
404	1.0441	2	1.0457	2
1, 0, 13	1.0385	1	—	—
318	0.9950	5	0.9969	3
0, 2, 13	0.9683	3	—	—
324	0.9646	5	—	—
140	0.9552	5	—	—
143	0.9356	3	—	—
048	0.9260	2	—	—

*Hexagonal indices.
†Lines absent in ilmenite pattern.

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