

**GEDRITE FROM THE YELLOWKNIFE-BEAULIEU REGION,  
DISTRICT OF MACKENZIE, N.W.T.**

D. C. KAMINENI AND A. S. WONG

*Dept. of Geology, University of Ottawa, Ottawa*

INTRODUCTION AND MODE OF OCCURRENCE

The Yellowknife-Beaulieu region is underlain by Precambrian rocks that form part of the Slave Province of the Canadian Shield. The lithological units of the area are mainly metavolcanics and metasediments (the Yellowknife Group), granites, granodiorites, pegmatites and diabases. The Precambrian geologic history of the region was described by Henderson & Jolliffe (1941), Folinsbee (1942), and Henderson (1943).

Gedrite, which is an aluminous orthoamphibole, occurs in the meta-sedimentary rocks to the east of the Sparrow Lake granitic pluton, which lies about 40 km northeast of the town of Yellowknife. Lithologically, the gedrite-bearing rocks may be termed as metagreywacke and argillite. Primary features, such as graded bedding and layering, are commonly preserved in these rocks and gedrite is restricted to certain layers, indicating a compositional control in its paragenesis.

The gedrite has a dark green to brownish needle-like habit and commonly forms sheaf-like aggregates. The associated minerals are cordierite, biotite, almandine and oligoclase. Other phases, that may or may not be present, are ilmenite, magnetite and pyrrhotite. Gedrite-cummingtonite associations are observed most frequently in contact zones between gedrite-bearing rocks and siliceous concretions in which cummingtonite is abundantly developed. The concretions occur as thin layers and ellipsoidal lenses within the metasedimentary rocks.

PHYSICAL AND OPTICAL PROPERTIES

The gedrite was separated from a rock also containing garnet, biotite, cordierite, oligoclase, and ilmenite. The sample was handpicked to achieve a purity of 99% or better.

The density determined by suspension in a mixture of methylene iodide and dimethylsulphoxide is approximately 3.27. The calculated density, based on chemical composition and cell dimensions, is 3.32.

The optical properties are as follows :

X = pale yellow, Y = yellowish brown, Z = greyish green

$\alpha = 1.673 \pm 0.002$ ,  $\beta = 1.684 \pm 0.002$ ,  $\gamma = 1.692 \pm 0.002$

Optically +,  $2V = 77^\circ$  to  $79^\circ$ .

Refractive indices obtained on the basis of chemical composition and regression equations of Hey (1956) are  $\alpha = 1.6708 \pm 0.0025$ ,  $\beta = 1.6787 \pm 0.0015$ ,  $\gamma = 1.6896 \pm 0.0012$ .

Deer, Howie & Zussman (1961) plotted  $\gamma$  of anthophyllite-gedrite against  $100 \text{ Mg} : (\text{Mg} + \text{Fe}^{2+} + \text{Fe}^{3+} + \text{Mn})$ . From this diagram, a  $\gamma$  value of 1.692 is obtained, which is in agreement with our measured value.

#### CHEMICAL COMPOSITION

The mineral was analysed by employing a combination of atomic absorption, wet chemical and electron microprobe techniques; the analysis is given in Table 1.

TABLE 1. CHEMICAL COMPOSITION OF GEDRITE

		No. of ions on the basis of 24 (O, OH)			
SiO <sub>2</sub>	43.64	Si	6.46	}	8.00
TiO <sub>2</sub>	0.31	Al	1.54		
Al <sub>2</sub> O <sub>3</sub>	16.42	Al	1.32		
Fe <sub>2</sub> O <sub>3</sub>	1.26	Ti	0.03	}	7.03
FeO	24.52	Fe <sup>3+</sup>	0.14		
MnO	0.77	Fe <sup>2+</sup>	3.03		
MgO	8.95	Mn	0.10		
CaO	0.42	Mg	1.97		
Na <sub>2</sub> O	1.23	Ca	0.06		
K <sub>2</sub> O	0.20	Na	0.35	}	2.33
H <sub>2</sub> O <sup>+</sup>	2.36	K	0.04		
H <sub>2</sub> O <sup>-</sup>	0.20	OH	2.33		
Total	100.28				

TABLE 2. COMPARISON OF UNIT CELL DIMENSIONS

	Present work	Milton & Ito (1961)	Papike & Ross (1970)	
a(Å)	18.557	18.594	18.594	18.601
b(Å)	17.873	17.890	17.741	17.839
c(Å)	5.283	5.304	5.249	5.284

TABLE 3. X-RAY DIFFRACTION DATA FOR GEDRITE

<i>hkl</i>	<i>d</i> (calc. Å)	<i>d</i> (obser. Å)	<i>I</i> / <i>I</i> <sup>0</sup>
020	8.94	8.98	65
210	8.24	8.25	100
230	5.01	—	—
111	4.89	—	—
400	4.64	4.64	5
040	4.47	4.47	10
420	4.12	4.13	10
131	3.87	3.88	5
231	3.64	3.64	10
331	3.33	3.34	10
440	3.22	3.22	90
610	3.05	3.06	100
341	2.988	—	—
521	2.876	2.878	20
260	2.836	—	—
251	2.821	2.823	40
630 } 441 }	2.745	2.750	40
531	2.706	—	—
351	2.671	2.674	40
161	2.570	2.571	30
202	2.541	2.543	10
451	2.496	2.502	40
302	2.429	2.433	5
650	2.339	2.341	5
551	2.315	2.314	5
271	2.231	2.230	8
502	2.152	2.152	10
561	2.127	2.127	10
821	2.067	2.067	8
480	2.013	—	—
661	1.9884	1.9870	5
750	1.9756	—	—
702 } 940 }	1.8730	1.8728	5
931	1.8281	1.8259	20
0.10.0	1.7873	1.7876	5
10.3.0	1.7717	1.7728	10
961	1.6150	1.6159	30
2.11.0	1.6007	1.6001	20
922	1.5991	1.5994	30
11.2.1	1.5817	1.5822	10
6.10.0 } 12.0.0 }	1.5475	1.5472	30
10.6.1	1.5110	1.5109	10
0.12.0	1.4894	1.4890	20
553	1.4536	1.4524	10
10.4.2 } 6.11.0 }	1.4384	1.4377	30

The Fe/Mg ratios of coexisting garnet, biotite and cordierite were also determined. Regarding their preference for iron relative to magnesium, the minerals may be placed in the order garnet > gedrite > biotite > cordierite.

#### X-RAY DIFFRACTION DATA

The x-ray powder diffraction data of gedrite that were reported by Milton & Ito (1961) showed a *Pnma* space group. This was confirmed in the single-crystal study by Papike & Ross (1970).

Powder photographs of the Yellowknife gedrite were taken with manganese-filtered iron radiation, and corrections for film shrinkage were applied. The results obtained by using a least-square refinement program are given in Tables 2 and 3.

#### ACKNOWLEDGEMENTS

This study was supported by a grant from the National Research Council of Canada, awarded to Dr. Ralph Kretz. Thanks are due to Dr. D. B. Stewart of the U.S.G.S. for providing his unit cell refinement program.

#### REFERENCES

- DEER, W.A., HOWIE, R.A. & ZUSSMAN, J. (1961) : *Rock-forming minerals*. Longmans, London.
- FOLINSBEE, R.E. (1942) : *Metamorphism and ore deposits of the Yellowknife-Beaulieu Area*. Ph.D. thesis, University of Minnesota, Minneapolis.
- HENDERSON, J.F. (1943) : Structure and metamorphism of Early Precambrian rocks between Gordon and Great Slave Lakes, N.W.T. *Amer. J. Sci.* **241**, 430-446.
- HENDERSON, J.F. & JOLLIFFE, A.W. (1941) : Beaulieu River, District of Mackenzie, Northwest Territories. *Geol. Surv. Can.*, Map **581A**.
- HEY, M.H. (1956) : On the correlation of physical properties with chemical composition in multivariate systems. *Mineral. Mag.* **31**, 69-95.
- MILTON, D.J. & ITO, J. (1961) : Gedrite from Oxford County, Maine. *Amer. Mineral.* **46**, 734-740.
- PAPIKE, J.J. & ROSS, M. (1970) : Gedrites : Crystal structures and intracrystalline cation distributions. *Amer. Mineral.* **55**, 1945-1972.

*Manuscript received December 1971.*