

# MinIdent-Win - biotite

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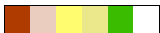


**Formula:**  $K(Mg,Fe^{2+})_3(Al,Fe^{3+})Si_3O_{10}(OH,F)_2$   
**Status:** Mineral name is IMA approved or traditional  
**Level:** Series  
**Parents:** mica-family  
**Symmetry:** Monoclinic  
**Mean Atomic Number:** 13.7  
**Diffraction Values:** 10.100, 3.360, 2.650, 2.450, 2.183

**Kretz abbreviation:** Bt  
**First Described** in 1847  
**Space Group:** Cm  
**Z number:** 2  
**ICDD (TM) Number:** 2-45

	Minimum	Maximum	Average	Std. Dev.
a (A)	5.200	5.402	5.348	
b (A)	9.186	9.334	9.249	
c (A)	10.129	10.447	10.256	
Alpha	90.000	90.000	90.000	
Beta	95.017	100.852	100.010	
Gamma	90.000	90.000	90.000	
Volume	480.555	489.796	485.177	

	Minimum	Maximum	Average	Std. Dev.
n(Alpha)	1.513	1.677	1.589	
n(Beta)	1.539	1.720	1.630	
n(Gamma)	1.540	1.721	1.632	
Max. birefrin	0.026	0.078	0.042	
2V Gamma	0	180	153	

**Optical Sign:** -ve      **OAP Orientation:** Anomalous

<b>C(Alpha)</b>		Brown, Pale Brown, Yellow, Greyish Yellow, Brownish Green, Colourless
<b>C(Beta)</b>		Brown, Dark Brown, Brownish Red, Dark Brownish Red, Yellow, Dark Green
<b>C(Gamma)</b>		Brown, Dark Brown, Brownish Red, Dark Brownish Red, Yellow, Dark Green
<b>Dispersion</b>	Both	

	Minimum	Maximum	Average	Std. Dev.
Mohs	2.0	3.0	2.6	
Vickers	30	116	88	
Density	2.70	3.40	3.01	

	Total Min Wt (%)	Anal. Min Wt (%)	Average Wt (%)	Anal. Max Wt (%)	Total Max Wt (%)	Average Atomic	Coordination
H	0.0000	0.0000	0.4274	3.6100	3.6100	1.8881	
Li	0.0000	0.0000	0.0975	0.8825	0.8825	0.0627	6
C	0.0000	0.0000	0.0022	0.0218	0.0218	0.0008	
N	0.0000	0.0000	0.3540	2.0276	3.3161	0.1127	
O	29.3702	33.9364	40.7944	49.1468	49.1468	11.3761	
F	0.0000	0.0000	2.6103	9.3000	9.3000	0.6130	
Na	0.0000	0.0000	0.2755	2.6558	2.6558	0.0535	12
Mg	0.0000	0.0000	6.5472	17.4651	17.5232	1.2017	
Al	0.0000	0.6298	8.8578	12.0664	21.9373	1.4649	4 6
Si	10.6106	15.0001	17.1053	21.5689	26.4557	2.7170	4
P	0.0000	0.0000	0.0010	0.0436	0.0436	0.0001	4
S	0.0000	0.0000	0.0030	0.0300	0.0300	0.0004	4
Cl	0.0000	0.0000	0.0871	1.1100	1.1100	0.0110	
K	0.0000	0.6890	7.0875	9.9037	9.9037	0.8088	12
Ca	0.0000	0.0000	0.2195	1.2507	1.2507	0.0244	12
Ti	0.0000	0.0000	1.0200	5.3776	15.5575	0.0950	6
V	0.0000	0.0000	0.0375	7.3956	7.3956	0.0033	6
Cr	0.0000	0.0000	0.1093	5.9252	5.9252	0.0094	6

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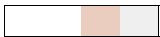

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<b>Mn</b>	0.0000	0.0000	0.2638	4.8326	17.8325	0.0214	6
<b>Fe</b>	0.0000	0.0000	17.0751	32.9637	41.7230	1.3641	6
<b>Co</b>	0.0000	0.0000	0.0001	0.0035	0.0035	0.0000	6
<b>Ni</b>	0.0000	0.0000	0.0142	0.1493	0.1493	0.0011	6
<b>Zn</b>	0.0000	0.0000	0.0573	3.2376	3.2376	0.0039	
<b>Ga</b>	0.0000	0.0000	0.0001	0.0020	0.0020	0.0000	
<b>Rb</b>	0.0000	0.0000	0.0493	1.6917	1.6917	0.0026	12
<b>Sr</b>	0.0000	0.0000	0.0007	0.0085	0.0085	0.0000	12
<b>Zr</b>	0.0000	0.0000	0.0001	0.0040	0.0040	0.0000	6
<b>Cs</b>	0.0000	0.0000	0.0137	0.4195	0.4195	0.0005	12
<b>Ba</b>	0.0000	0.0000	0.4069	9.5835	14.7579	0.0132	12
<b>Total</b>			103.5178			21.8496	

Atomic proportions calculated for O+F+Cl = 12.0

Compilation based on 3 general and 15 sample records

*Values in italics are calculated from the minimum and maximum values. Other data are from the sample and general records.*

<b>Lustre</b>	Submetallic, Adamantine, Subadamantine, Vitreous, Pearly
<b>Aggregation</b>	Foliaceous, Massive, Lamellar, Scaly
<b>Habit</b>	Hexagonal, Platy, Tabular, Prismatic, Flaky
<b>Tenacity</b>	Flexible, Elastic, Tough
<b>Fracture</b>	Ragged
<b>Cleavage</b>	{001} Perfect
<b>Surface Colour</b>	 Brown, Dark Brown, Brownish Black, Greenish Brown, Green, Dark Green, Greenish Black
<b>Streak</b>	 Colourless, White, Pale Brown, Pale Grey
<b>Other lumin.</b>	 Cathodoluminescent: Blue

Comp. Plan.	Comp. Surf.	Twin Plane	Twin Axis	Notes
{001}			[310]	

**Notes on hand specimen data:** Thin cleavage flakes are very elastic.

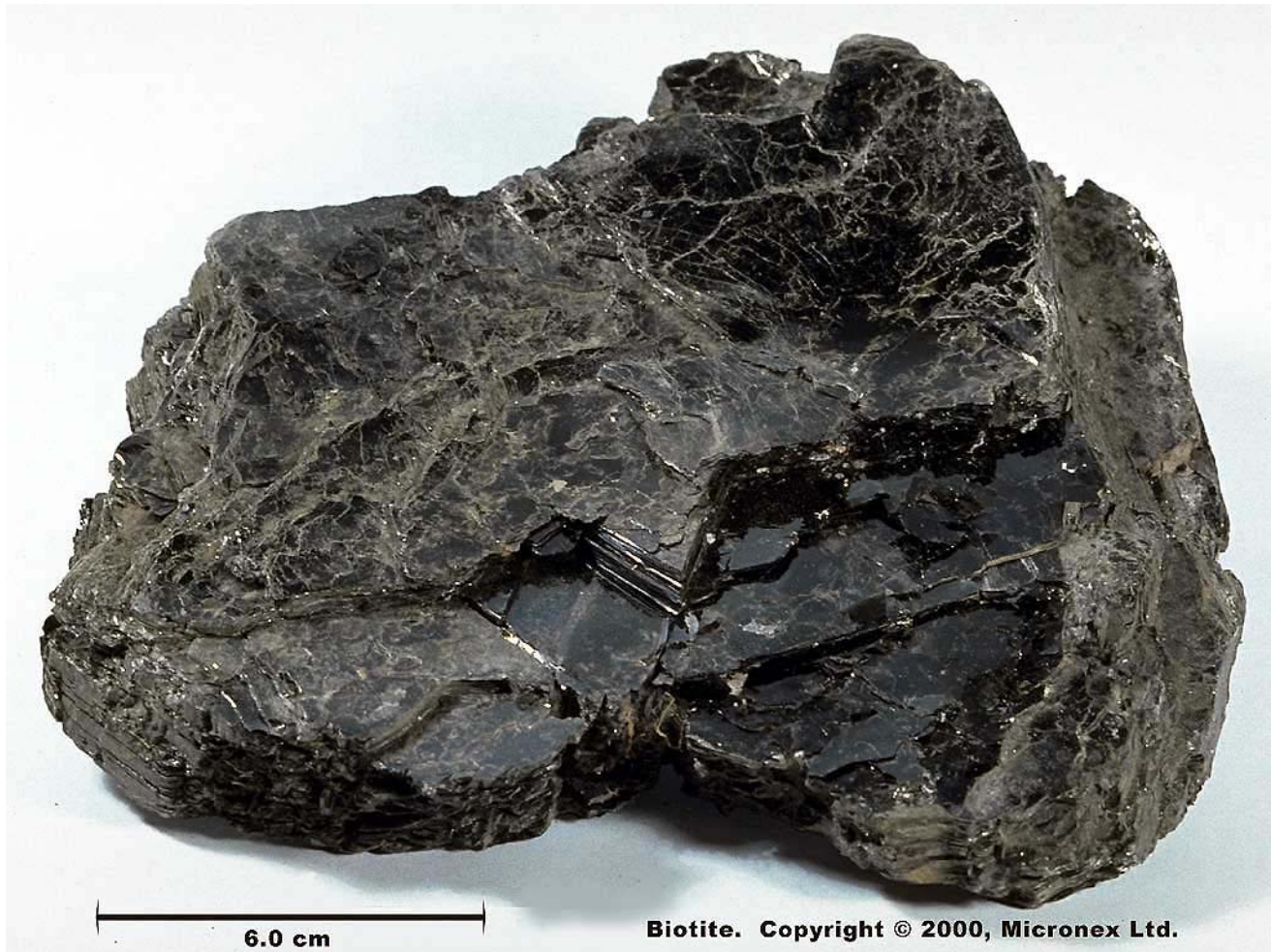
**Synonyms:** lepidomelane, manganophyllite, anomite, caesium-biotite, calciobiotite, chrombiotite, ferribiotite, ferrititanbiotite, ferriwotomite, ferriwodanite, ferromuscovite, haughtonite, heterophyllite, hydroxyl-biotite, manganese-mica, manganophyll, merxene, natro-alumobiotite, natronbiotite, natronphlogopite, odenite, odinit, odith, titanbiotite, titanglimmer, titanmica, titanobiotite, wodanite, wotomite

**Remarks:** Usually black or dark brown but may be reddish or greenish-brown. The lustre is vitreous to pearly. Sometimes very large, pseudo-hexagonal crystals occur but more commonly biotite forms grains or flakes that are usually disseminated but are sometimes aggregated into masses. A perfect basal cleavage produces somewhat flexible laminae that are transparent to opaque (depending on thickness and Fe content). Several different polytypes exist. (1M, 2M(1), 4M(3) & 6A—the cell data reported here are for the 1M polytype). According to the IMA-sponsored review of the nomenclature of the micas, biotite is no longer a mineral species but has been given "series" status with end members annite, phlogopite, siderophyllite and eastonite. Most minerals identified in the hand specimen as biotite can be shown by microanalysis to be a solid solution of two or more of these end-members. Examples approaching the eastonite end-member are yet to be located occurring naturally.

**Occurrences:** A very common mineral occurring in many igneous and metamorphic rocks and persisting as a detrital mineral in some sediments.

# MinIdent-Win

Massive biotite



Dorian G.W. Smith

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**Caption:** A platy mass of dark brown biotite shows very clearly its perfect cleavage and the vitreous to subadamantine lustre of the fresh cleavage surfaces. Note that although this is seldom described in texts, there is also a good pseudotrigonal (prismatic cleavage) almost perpendicular to the basal cleavage, which gives rise to triangular shaped fragments. Mohs' hardness of biotite is about 2.5 on the basal cleavage surfaces but about three at right angles to them. Locality: Silver Crater mine, Bancroft, Ontario, Canada.

**Keywords:** biotite; massive; Silver Crater mine; Bancroft; Ontario; Canada; perfect cleavage; subadamantine; sheet silicates; phyllosilicates; micas

**Acknowledgements:** From the personal collections of Dorian Smith. Photography by Frank Dimitrov and Dorian Smith.

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**Localities of samples used in compilation:** Chokolowska Valley, Tatra Mountains, Poland. Morar, Inverness-shire; Carn Chuinneag-Inchbae region, Ross-shire; Cairnsmore of Carsphairn, Kirkcudbrightshire; Glen Esk, Angus; Bellhelvie, Aberdeenshire, Scotland. Lakeview & Woodson & Rubideaux, California; Alboroto, San Juan district, Colorado, U.S.A. Mourne Mountains, Northern Ireland. Northern Nigeria. Seto, Ogawa-mati, Nakoso City, Fukushima Prefecture; Kaiya, Tabilo-mua, Gosaisyo-Takanuki district; Tenayokyo, Simoina-goni, Nagano Prefecture; Japan. Keretti and Vuonos mines, Outokumpu district, Karelia, Finland. Other localities worldwide.

**References:** Lithos v.20, p.218. J. Petrol v.28, p.867-886. Deer et al. (1962) v.3, p.55-84. Roberts et al. (1974) Encycl. Mins. USGS Bull. 1627. Z. Krist. v.97, p.514-521. Dana (6th) p.634. Min. Mag., v.31, p.236-244. Bragg & Claringbull (1965) Crystal Structures of Minerals.