Middlebackite $Cu_2C_2O_4(OH)_2$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. As aggregates of prismatic crystals to 0.3 mm comprised of individual crystals to 0.05 mm.

Physical Properties: *Cleavage*: One perfect. *Tenacity*: Brittle. *Fracture*: Uneven. Hardness = ~2 D(meas.) = n.d. D(calc.) = 3.64

Optical Properties: Translucent. *Color*: Blue. *Streak*: Pale blue. *Luster*: Vitreous. *Optical Class*: Biaxial (+). α = 1.663(4) β = 1.748(4) γ = 1.861(4) 2V(calc.) = 86.7° *Dispersion*: Slight, *r* > *v*. *Pleochroism*: *X* = colorless, *Y* = very pale blue, *Z* = dark sky blue. *Absorption*: *Z* > *Y* > *X*.

Cell Data: *Space Group*: $P2_1/c$. *a* = 7.2597(15) *b* = 5.7145(11) *c* = 5.6624(11) β = 104.20(3)° Z = 2

X-Ray Diffraction Pattern: Iron Monarch quarry, South Australia, Australia. 3.739 (100), 2.860 (18), 7.070 (16), 2.481 (12), 2.350 (9), 2.373 (8), 2.905 (7)

Chemistry:

	(1)	(2)
C_2O_3	[28.91]	28.91
CuO	64.18	63.86
ZnO	0.16	
FeO	0.07	
P_2O_5	0.1	
Cl	0.35	
H_2O	[7.23]	7.23
-O = Cl	0.08	.
Total	100.92	100.00

(1) Iron Monarch quarry, South Australia, Australia; average electron microprobe analysis supplemented by IR spectroscopy, H_2O and C_2O_3 calculated; corresponding to $Cu_{2.00}(C_2O_4)Cl_{0.02}(OH)_{1.98}$. (2) $Cu_2C_2O_4(OH)_2$.

Occurrence: A supergene mineral in a weathered Precambrian manganiferous sedimentary iron ore deposit. A source of oxalate was probably decaying organic matter. Copper from weathering of Cu sulfides with dissolution of Cu possibly facilitated by oxalic acid.

Association: Atacamite, mottramite.

Distribution: From the upper levels of the Iron Monarch quarry, South Australia, Australia.

Name: For the *Middleback* Range, in which the Iron Monarch quarry is located.

Type Material: South Australian Museum, Adelaide, South Australia, Australia (G34300).

References: (1) Elliott, P. (2019) Middlebackite, a new Cu oxalate mineral from Iron Monarch, South Australia: Description and crystal structure. Mineral. Mag., 83, 427-433.