Nollmotzite $Mg[U^{5+}(U^{6+}O_2)_2O_4F_3]\cdot 4H_2O$

Crystal Data: Monoclinic. *Point Group*: *m.* As prisms with chisel-like terminations to ~0.3 mm, elongated along [010] that display {100}, {001}, and {120}.

Physical Properties: *Cleavage*: Perfect on {001}. *Tenacity*: Brittle. *Fracture*: n.d. Hardness = n.d. D(meas.) = n.d. D(calc.) = n.d.

Optical Properties: Transparent. *Color*: Deep violet-brown. *Streak*: n.d. *Luster*: Vitreous. *Optical Class*: Biaxial (-). $\alpha = 1.615(3)$ $\beta = 1.750(5)$ $\gamma = 1.765(5)$ 2V(meas.) = 37(1)° 2V(calc.) = 34.6° *Orientation*: $X \approx c^*$, $Y = b$, $Z \approx a$, $X \wedge c \approx 9°$ in obtuse angle β. *Dispersion*: Strong, $r > v$. *Pleochroism*: Strong, X = colorless, Y = red-brown, Z = deep violet. *Absorption*: $X << Y < Z$.

Cell Data: *Space Group*: *Cm*. $a = 7.1015(12)$ $b = 11.7489(17)$ $c = 8.1954(14)$ $\beta = 98.087(14)°$ Z = 2

X-ray Powder Pattern: Clara mine, Black Forest Mountains, Baden-Württemberg, Germany. 8.10 (100), 3.420 (54), 2.015 (32), 4.06 (31), 3.518 (30), 3.083 (26), 3.237 (22)

Chemistry:

	(1)
MgO	4.20
CuO	0.12
U_2O_5	[27.28]
UO_3	[56.12]
F	5.87
H_2O	[6.80]
$- O = F_2$	2.47
Total	97.92

(1) Clara mine, Black Forest Mountains, Baden-Württemberg, Germany; average of 6 electron microprobe analyses supplemented by Raman spectroscopy, H_2O calculated from structure, total U as UO_3 = 84.18 apportioned by structural data to U_2O_5 and UO_3; corresponds to $(Mg_{1.06}Cu_{0.02})_{\Sigma=1.08}[U^{5+}(U^{6+}O_2)_2O_{3.85}F_{3.15}][(H_2O)_{3.69}(OH)_{0.31}]_{\Sigma=4.00}$.

Occurrence: Formed by precipitation from U-containing aqueous solutions under partially reducing conditions most probably enhanced by consumption of oxygen during the oxidation of abundant pyrite present in the gangue.

Association: Fluorite, barite.

Distribution: From the dump of the Clara mine, Black Forest Mountains, Baden-Württemberg, Germany.

Name: Honors two German mineral collectors who found this new mineral. It combines the first four letters of their surnames: Markus *Noll*er (b. 1977) and Reinhard *Motz*igemba (b. 1952).

Type Material: Natural History Museum of Los Angeles County, Los Angeles, California, USA (66647, 66648 and 66649).

References: (1) Plášil, J., A.R. Kampf, R. Škoda, and J. Čejka (2018) Nollmotzite, $Mg[U^{V}(U^{VI}O_2)_2O_4F_3]\cdot 4H_2O$, the first natural uranium oxide containing fluorine. Acta Crystal., B74(4), 362-369. (2) (2021) Amer. Mineral., 106, 163 (abs. ref. 1).