Maoniupingite-(Ce) $(Ce, Ca)_4(Fe^{3+}, Ti, Fe^{2+}, \square)(Ti, Fe^{3+}, Fe^{2+}, Nb)_4Si_4O_{22}$

Crystal Data: Hexagonal. *Point Group*: $\bar{3}$. As subhedral to euhedral tabular crystals, to 2 cm.

Physical Properties: *Cleavage*: None. *Tenacity*: Brittle. *Fracture*: Conchoidal. Hardness = ~6 VHN: 72.2-89.2, 83.8 average (0.2 kg load). D(meas.) = 4.62(8) D(calc.) = 4.767 Metamict.

Optical Properties: Opaque. *Color*: Black; in reflected light, grayish white, with no internal reflections. *Streak*: Black. *Luster*: Submetallic.
Optical Class: Isotropic, very weakly anisotropic. Exhibits neither bireflectance nor pleochroism. R_1-R_2: (400) 18.4-16.4, (420) 19.9-18.9, (440) 19.8-18.9, (460) 19.2-18.5, (470) 19.0-18.3, (480) 18.8-18.1, (500) 18.5-17.9, (520) 18.2-17.6, (540) 18.0-17.4, (546) 17.9-17.4, (560) 17.7-17.1, (580) 17.5-16.9, (589) 17.4-16.8, (600) 17.3-16.7, (620) 17.1-16.5, (640) 17.0-16.3, (650) 16.9-16.2, (660) 16.8-16.1, (680) 16.8-16.1, (700) 16.5-15.7

Cell Data: *Space Group*: $R\bar{3}$. a = 10.3462(5) c = 20.837(2) Z = 3

X-ray Powder Pattern: Baozi Hill, near the Maoniuping REE deposit, Sichuan province, China. 2.627 (100), 2.144 (100), 3.065 (75), 2.254 (70), 1.545 (60), 2.883 (55), 2.476 (55)

Chemistry:

	(1)		(1)
P_2O_5	0.03	Fe_2O_3	[27.75]
V_2O_5	0.57	Y_2O_3	0.55
Nb_2O_5	0.59	La_2O_3	0.67
SiO_2	0.02	Ce_2O_3	1.12
TiO_2	53.12	Nd_2O_3	0.11
ZrO_2	0.15	MgO	0.05
ThO_2	0.15	CaO	0.03
UO_2 total	8.05	MnO	1.11
UO_2	[6.44]	SrO	0.20
UO_3	[1.71]	BaO	0.30
Al_2O_3	0.07	PbO	2.56
Cr_2O_3	0.07	Na_2O	0.21
Fe_2O_3 total	28.78	K_2O	0.09
FeO	[0.93]	Total	98.60

(1) Baozi Hill, near the Maoniuping REE deposit, China; average electron microprobe analysis supplemented by X-ray photoelectron spectroscopy, UO_2 and UO_3 calculated from total UO_2, FeO and Fe_2O_3 calculated from total Fe_2O_3; corresponds to $[\square_{0.322}(Pb_{0.215}Ba_{0.037}Sr_{0.036}Ca_{0.010})_{\Sigma=0.298}(Ce_{0.128}La_{0.077}Nd_{0.012})_{\Sigma=0.217}(Na_{0.127}K_{0.036})_{\Sigma=0.163}]_{\Sigma=1.000}(U^{4+}_{0.447}Mn_{0.293}U^{6+}_{0.112}Y_{0.091}Zr_{0.023}Th_{0.011})_{\Sigma=0.977}(Fe^{3+}_{1.224}Fe^{2+}_{0.243}Mg_{0.023}P_{0.008}Si_{0.006}\square_{0.496})_{\Sigma=2.000}(Ti_{12.464}Fe^{3+}_{5.292}V^{5+}_{0.118}Nb_{0.083}Al_{0.026}Cr^{3+}_{0.017})_{\Sigma=18.000}O_{38}$.

Mineral Group: Crichtonite group.

Occurrence: In fractures in lamprophyre veins and along the contact between lamprophyre and a later quartz-alkali feldspar syenite dike with REE mineralization.

Association: Microcline, albite, quartz, iron-rich phlogopite, augite, muscovite, calcite, baryte, fluorite, epidote, pyrite, magnetite, hematite, galena, hydroxylapatite, titanite, ilmenite, rutile, garnet-group minerals, zircon, allanite-(Ce), monazite-(Ce), bastnäsite-(Ce), parisite-(Ce), maoniupingite-(Ce), thorite, pyrochlore-group minerals, chlorite.

Distribution: From Baozi Hill, near the Maoniuping REE deposit, Mianning county, Sichuan province, China.

Name: For the occurrence near the *Maoniuping* REE deposit, China.

Type Material: Geological Museum of China, Beijing (M12189).

References: (1) X. Ge, G. Fan, G. Li, G. Shen, Z. Chen, and Y. Ai (2017) Mianningite, $(\square,Pb,Ce,Na)(U^{4+},Mn,U^{6+})Fe^{3+}_2(Ti,Fe^{3+})_{18}O_{38}$, a new member of the crichtonite group from Maoniuping *REE* deposit, Mianning county, southwest Sichuan, China. Eur. J. Mineral., 29, 331-8.