

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

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). $D(\text{meas.}) = 4.62(8)$ $D(\text{calc.}) = 4.767$ 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 birefractance 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 ₂ O ₅	0.03	Fe ₂ O ₃	[27.75]
V ₂ O ₅	0.57	Y ₂ O ₃	0.55
Nb ₂ O ₅	0.59	La ₂ O ₃	0.67
SiO ₂	0.02	Ce ₂ O ₃	1.12
TiO ₂	53.12	Nd ₂ O 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 ₂ O ₃	0.07	PbO	2.56
Cr ₂ O ₃	0.07	Na ₂ O	0.21
Fe ₂ O ₃ total	28.78	<u>K₂O</u>	<u>0.09</u>
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, UO₂ and UO₃ calculated from total UO₂, FeO and Fe₂O₃ calculated from total Fe₂O₃; corresponds to $[\square_{0.322}(\text{Pb}_{0.215}\text{Ba}_{0.037}\text{Sr}_{0.036}\text{Ca}_{0.010})_{\Sigma=0.298}(\text{Ce}_{0.128}\text{La}_{0.077}\text{Nd}_{0.012})_{\Sigma=0.217}(\text{Na}_{0.127}\text{K}_{0.036})_{\Sigma=0.163}]_{\Sigma=1.000}(\text{U}^{4+}_{0.447}\text{Mn}_{0.293}\text{U}^{6+}_{0.112}\text{Y}_{0.091}\text{Zr}_{0.023}\text{Th}_{0.011})_{\Sigma=0.977}(\text{Fe}^{3+}_{1.224}\text{Fe}^{2+}_{0.243}\text{Mg}_{0.023}\text{P}_{0.008}\text{Si}_{0.006}\square_{0.496})_{\Sigma=2.000}(\text{Ti}_{12.464}\text{Fe}^{3+}_{5.292}\text{V}^{5+}_{0.118}\text{Nb}_{0.083}\text{Al}_{0.026}\text{Cr}^{3+}_{0.017})_{\Sigma=18.000}\text{O}_{38}$.

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, $(\square, \text{Pb, Ce, Na})(\text{U}^{4+}, \text{Mn, U}^{6+})\text{Fe}^{3+}_2(\text{Ti, Fe}^{3+})_{18}\text{O}_{38}$, a new member of the crichtonite group from Maoniuping REE deposit, Mianning county, southwest Sichuan, China. *Eur. J. Mineral.*, 29, 331-8.