

Arrojadite-(PbFe)

Crystal Data: Monoclinic. *Point Group:* *m*. As corroded crystals to ~1 mm.

Physical Properties: *Cleavage:* On {001}. *Tenacity:* Brittle. *Fracture:* n.d. Hardness = 3.5–4 D(meas.) = n.d. D(calc.) = 3.596 Nonfluorescent.

Optical Properties: Transparent. *Color:* Pale honey-yellow. *Streak:* White. *Luster:* Vitreous. *Optical Class:* Biaxial (+). $\alpha = 1.6585(5)$ $\beta = 1.6600(5)$ $\gamma = 1.6680(5)$ $2V(\text{meas.}) = 58.2(1)^\circ$ $2V(\text{calc.}) = 47^\circ$ *Dispersion:* $r > v$. *Orientation:* $X = b$. *Pleochroism:* None.

Cell Data: *Space Group:* *Cc*. $a = 16.4304(9)$ $b = 9.9745(5)$ $c = 24.5869(13)$ $\beta = 105.485(2)^\circ$ $Z = 4$

X-Ray Diffraction Pattern: Calculated pattern.

3.02 (100), 2.698 (55), 3.21 (43), 2.83 (35), 2.820 (33), 2.694 (32), 2.538 (30)

Chemistry:	(1)	(2)		(1)	(2)
P ₂ O ₅	[40.00]	37.41	SiO ₂	0.11	
Al ₂ O ₃	2.30	2.23	TiO ₂	0.03	
FeO	18.38	44.18	SrO	0.45	
MnO	13.70		BaO	2.01	
ZnO	0.19		PbO	5.29	9.81
MgO	6.64		F	0.53	
Li ₂ O _{LAM}	0.606		H ₂ O	[1.02]	1.19
Na ₂ O	4.60	2.72	<u>–O = F</u>	<u>0.22</u>	
K ₂ O	0.66		Total	99.00	100.00
CaO	2.15	2.46			

(1) Sapucaia pegmatite, Galileia, Minas Gerais, Brazil; average electron microprobe analysis, H₂O and P₂O₅ calculated. (2) $^{A1}\text{Pb}^{A2}\square^{B1}\text{Fe}^{B2}\square^{Na1,2}\text{Na}_2^{Na3}\square^{Ca}\text{Ca}^M\text{Fe}_{13}\text{Al}(\text{PO}_4)_{11}^{Plx}(\text{PO}_3\text{OH})^W(\text{OH})_2$.

Polymorphism & Series: Forms a series with dickinsonite.

Mineral Group: Arrojadite group. $\text{A}_2\text{B}_2\text{CaNa}_{2+x}\text{M}_{13}\text{Al}(\text{PO}_4)_{11}(\text{PO}_3\text{OH}_{1-x})\text{W}_2$.

Occurrence: A high-temperature ($\approx 800^\circ\text{C}$) primary mineral in granite pegmatites.

Association: Triphylite, chloritized biotite, albite.

Distribution: In the Sapucaia pegmatite, Galileia, Rio Doce basin, Minas Gerais, Brazil.

Name: *Arrojadite* indicates a member of the group with Fe²⁺ dominant at the *M* site; two suffixes indicate the dominant cation of the dominant valence state at the *A* and *B* sites. Honors Miguel Arrojado Ribeiro Lisbôa (1872–1932), Brazilian geologist.

Type Material: Mineral Museum, School of Mines, Paris, France (32088).

References: (1) Chopin, C., R. Oberti, and F. Cámara (2006) The arrojadite enigma: II. Compositional space, new members, and nomenclature of the group. *Amer. Mineral.*, 91, 1260–1270. (2) Cámara, F., R. Oberti, C. Chopin, and O. Medenbach (2006) The arrojadite enigma: I. A new formula and a new model for the arrojadite structure. *Amer. Mineral.*, 91, 1249–1259.