

**Sabugalite****HAl(UO<sub>2</sub>)<sub>4</sub>(PO<sub>4</sub>)<sub>4</sub>•16H<sub>2</sub>O**

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**Crystal Data:** Monoclinic, pseudotetragonal. *Point Group:* 2/*m*. Crystals, to 1 mm, very thin on {001}, square to lathlike outlines, typically warped, in composite subparallel growths; typically in thick crusts.

**Physical Properties:** *Cleavage:* On {001}, perfect. *Tenacity:* Somewhat flexible. Hardness = 2.5 D(meas.) = ~3.20 D(calc.) = 3.150 Radioactive; fluoresces bright lemon-yellow under SW and LW UV.

**Optical Properties:** Transparent to translucent. *Color:* Bright yellow to lemon-yellow.

*Luster:* Weakly vitreous.

*Optical Class:* Biaxial (-). *Pleochroism:* X = colorless; Y = Z = pale yellow. *Orientation:* Z = elongation.  $\alpha = 1.564\text{--}1.565$   $\beta = 1.581\text{--}1.583$   $\gamma = 1.582\text{--}1.584$  2V(meas.) = Moderately large, may be 0°.

**Cell Data:** *Space Group:* C2/*m* (synthetic).  $a = 19.426$   $b = 9.483$   $c = 9.850$   
 $\beta = 96.161^\circ$   $Z = 2$

**X-ray Powder Pattern:** Sabugal, Portugal.

9.69 (10), 4.86 (9), 3.47 (8), 2.188 (6), 4.39 (4), 2.452 (2), 2.389 (2)

<b>Chemistry:</b>	(1)	(2)	(3)		(1)	(2)	(3)
UO <sub>3</sub>	65.22	65.01	64.41	Al <sub>2</sub> O <sub>3</sub>	2.65	3.20	2.87
P <sub>2</sub> O <sub>5</sub>	16.08	14.02	15.98	CaO		0.36	
As <sub>2</sub> O <sub>5</sub>		2.70		H <sub>2</sub> O	15.93	[14.71]	16.74
				Total	99.88	[100.00]	100.00

(1) Quarta Feira mine, Portugal; corresponds to H<sub>1.00</sub>Al<sub>0.94</sub>(UO<sub>2</sub>)<sub>4.12</sub>(PO<sub>4</sub>)<sub>4.08</sub>•15.96H<sub>2</sub>O.

(2) Kariz, Portugal; H<sub>2</sub>O by difference; corresponds to H<sub>1.00</sub>Al<sub>1.12</sub>(UO<sub>2</sub>)<sub>4.08</sub> [(PO<sub>4</sub>)<sub>3.56</sub>(AsO<sub>4</sub>)<sub>0.42</sub>]<sub>Σ=3.98</sub>•15.96H<sub>2</sub>O. (3) HAl(UO<sub>2</sub>)<sub>4</sub>(PO<sub>4</sub>)<sub>4</sub>•16H<sub>2</sub>O.

**Mineral Group:** Autunite group.

**Occurrence:** A secondary mineral formed in the oxidized zone of uranium veins.

**Association:** Meta-autunite, saléeite, phosphuranylite.

**Distribution:** In Portugal, in Beira Alta, from the Quarta Feira and Coitos mines, Sabugal Co.; at Kariz, Minho Province; and elsewhere. From the Pedro Alvaro and Ciudad Rodrigo vanadium mines, Salamanca Province, Spain. In the Marnac mine, Compreignac, and the La Crouzille mine, Haute-Vienne, France. At Arcu su Linnarbu, near Capoterra, Sardinia, Italy. In the USA, from the Black Water mine, Black Mesa Basin, Apache Co., and at the Huskon and Arrowhead claims, Huskon district, near Cameron, Coconino Co., Arizona; in the Union Carbide mine, Maybell district, Moffat Co., at the Pitch mine, Marshall Pass district, Saguache Co., and the High Park claims, Teller Co., Colorado; from the Happy Jack mine, White Canyon, San Juan Co., Utah; at the Lucky Mc No. 20 mine, the Blue Buck claim and Blarco group, Fremont Co., the Poison Creek claim, Crook Co., and the Del Linch claim, Johnson Co., Wyoming. In the Sapucaia pegmatite mine, about 50 km east-southeast of Governador Valadares, Minas Gerais, Brazil. From the El Sharana mine, South Alligator Valley, Northern Territory, Australia.

**Name:** For Sabugal Co., Portugal, in which the mineral was first found.

**Type Material:** The Natural History Museum, London, England, 1958,733; Harvard University, Cambridge, Massachusetts, 102192, 102193; National Museum of Natural History, Washington, D.C., USA, 106335–106337.

**References:** (1) Frondel, C. (1951) Studies of uranium minerals (VIII): sabugalite, an aluminum-autunite. *Amer. Mineral.*, 36. 671–679. (2) Frondel, C. (1958) Systematic mineralogy of uranium and thorium. *U.S. Geol. Sur. Bull.* 1064, 196–200. (3) Vochten, R. and J. Pelsmaekers (1983) Synthesis, solubility, electrokinetic properties and refined crystallographic data of sabugalite. *Phys. Chem. Minerals*, 9, 23–29.

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