

**Crystal Data:** Orthorhombic. *Point Group:* *mm*2. Crystals pseudohexagonal, tabular on {001}, may be elongated along [110], to 5 mm. *Twinning:* Very common, on {110} and {111}, the latter producing sector-twinning aragonitelike groups.

**Physical Properties:** *Cleavage:* {001} perfect, {110} and {010} imperfect. *Tenacity:* Brittle. Hardness = n.d. D(meas.) = 5.28-5.36 D(calc.) = 5.25 Radioactive.

**Optical Properties:** Transparent to translucent. *Color:* Yellow to golden yellow and amber-yellow. *Luster:* Adamantine.

*Optical Class:* Biaxial (-).  $\alpha = 1.725-1.730$   $\beta = 1.780-1.822$   $\gamma = 1.790-1.829$   $2V(\text{meas.}) = \sim 36^\circ$  *Pleochroism:* Distinct; *X* = colorless to pale yellow; *Y* = *Z* = greenish yellow to deep golden yellow, amber-brown. *Orientation:* *X* = *c*; *Y* = *a*; *Z* = *b*. *Dispersion:*  $r > v$ , very strong.

**Cell Data:** *Space Group:* *Pbn*2<sub>1</sub>.  $a = 12.0941(8)$   $b = 30.211(2)$   $c = 7.1563(5)$   $Z = 4$

**X-ray Powder Pattern:** Shinkolobwe, Congo.

7.53 (10), 3.77 (9), 3.17 (8), 2.03 (6), 3.54 (5), 2.49 (4), 2.56 (3)

| Chemistry:       | (1)   | (2)    | (3)    |
|------------------|-------|--------|--------|
| UO <sub>3</sub>  | 82.76 | 84.39  | 83.00  |
| SiO <sub>2</sub> | 0.76  |        |        |
| CaO              | 0.30  |        |        |
| BaO              | 6.88  | 7.41   | 7.42   |
| H <sub>2</sub> O | 8.97  | 8.68   | 9.58   |
| Total            | 99.67 | 100.48 | 100.00 |

(1-2) Shaba Province, Congo. (3) Ba(UO<sub>2</sub>)<sub>6</sub>O<sub>4</sub>(OH)<sub>6</sub>·8H<sub>2</sub>O.

**Occurrence:** An uncommon alteration product of uraninite.

**Association:** Uranophane, fourmarierite, metatorbernite, rutherfordine, becquerelite, studtite, soddyite.

**Distribution:** From Shinkolobwe and in the Musonoi mine, near Kolwezi, Katanga Province, Congo (Shaba Province, Zaire). From the La Crouzille mine, and the Margnac mine, Compreignac, Haute-Vienne, and in the Rabéjac uranium deposit, seven km south-southeast of Lodève, Hérault, France. In Germany, at Wölsendorf, Bavaria; from Menzenschwand, and at Wittichen, Black Forest; and at Bergen, Vogtland, Saxony. On Mauch Chunk Ridge, Jim Thorpe, Carbon Co., Pennsylvania, and in the Delta mine, Emery Co., Utah, USA.

**Name:** Honors Valère Louis Billiet (1903-1945), Belgian crystallographer, University of Ghent, Ghent, Belgium.

**Type Material:** Harvard University, Cambridge, Massachusetts, 104455; National Museum of Natural History, Washington, D.C., USA, 160496.

**References:** (1) Vaes, J.F. (1947) Six nouveaux minéraux d'urane provenant de Shinkolobwe (Katanga). *Ann. Soc. Géol. Belg.*, 70, B212-B229, esp. B214-B217 (in French). (2) (1947) *Mineral. Abs.*, 10, 146 (abs. ref. 1). (3) (1948) *Amer. Mineral.*, 33, 384 (abs. ref. 1). (4) Frondel, J.W. and F. Cuttitta (1953) Studies of uranium minerals (XII): the status of billietite and becquerelite. *Amer. Mineral.*, 38, 1019-1024. (5) Frondel, C. (1958) Systematic mineralogy of uranium and thorium. *U.S. Geol. Sur. Bull.* 1064, 68-72. (6) Christ, C.L. and J.R. Clark (1960) Crystal chemical studies of some uranyl oxide hydrates. *Amer. Mineral.*, 45, 1026-1061. (7) Pagoaga, M.K., D.E. Appleman, and J.M. Stewart (1987) Crystal structure and crystal chemistry of the uranyl oxide hydrates becquerelite, billietite, and protasite. *Amer. Mineral.*, 72, 1230-1238. (8) Finch, R.J., P.C. Burns, F.C. Hawthorne, and R.C. Ewing (2006) Refinement of the crystal structure of billietite, Ba[(UO<sub>2</sub>)<sub>6</sub>O<sub>4</sub>(OH)<sub>6</sub>](H<sub>2</sub>O)<sub>8</sub>. *Can. Mineral.*, 44, 1197-1205. (9) (2007) *Amer. Mineral.*, 92(4), 706 (abs. ref. 8).