

**Brannerite****(U, Ca, Y, Ce)(Ti, Fe)<sub>2</sub>O<sub>6</sub>**

**Crystal Data:** Monoclinic; always metamict. *Point Group:* 2/m. As indistinct prismatic crystals, to 30 cm, some showing an orthogonal prism zone; more typically as rounded, detrital grains and pebbles and as irregular embedded grains and masses.

**Physical Properties:** *Fracture:* Conchoidal. Hardness = 4.5–5.5 D(meas.) = 4.2–5.43 D(calc.) = [5.20]; 6.37 (synthetic UTi<sub>2</sub>O<sub>6</sub>). Radioactive.

**Optical Properties:** Opaque, transparent in very thin fragments. *Color:* Black, brownish olive-green, yellow-brown to yellow with alteration; yellowish green in transmitted light. *Streak:* Dark greenish brown to yellowish brown. *Luster:* Pitchlike to vitreous when fresh, resinous to dull when altered.

*Optical Class:* Isotropic. *n* = 2.23–2.30

R: (400) 13.9, (420) 13.5, (440) 13.1, (460) 12.8, (480) 12.7, (500) 12.5, (520) 12.3, (540) 12.2, (560) 12.1, (580) 12.0, (600) 11.9, (620) 11.8, (640) 11.7, (660) 11.7, (680) 11.6, (700) 11.5

**Cell Data:** *Space Group:* C2/m (synthetic UTi<sub>2</sub>O<sub>6</sub>). *a* = 9.8123(15) *b* = 3.7697(6) *c* = 6.9253(9) *β* = 118.957(6)° *Z* = 2

**X-ray Powder Pattern:** Custer Co., Idaho, USA; recrystallized in air at 1000 °C.

3.41 (10), 1.903 (8), 4.73 (6), 3.32 (6), 2.462 (6), 2.276 (6), 1.864 (6)

Chemistry(1)		(2)			(1)	(2)	
UO <sub>3</sub>	33.5		UO <sub>2</sub>	10.3	62.83	BaO	0.3
SiO <sub>2</sub>	0.6		(Yt, Er) <sub>2</sub> O <sub>3</sub>	3.9		SrO	0.1
TiO <sub>2</sub>	39.0	37.17	FeO	2.9		H <sub>2</sub> O	2.0
ZrO <sub>2</sub>	0.2		PbO	0.2		CO <sub>2</sub>	0.2
ThO <sub>2</sub>	4.1		CaO	2.9		Total	100.2
							100.00

(1) Custer Co., Idaho, USA. (2) UTi<sub>2</sub>O<sub>6</sub>.

**Polymorphism & Series:** Dimorphous with orthobrannerite (?); forms a series with thorutite.

**Occurrence:** A primary mineral in granite pegmatite and in granitic gneiss; in silicified pebble conglomerates; in hydrothermal quartz and calcite veins; detrital in placers.

**Association:** Uraninite, gold, rutile, xenotime, apatite, zircon.

**Distribution:** In the USA, from Kelly Gulch, Custer Co., Idaho; in the San Bernardino Mountains, San Bernardino Co., and about ten km south of Coleville, Mono Co., California; at the California mine, Chaffee Co., Colorado; from Penn Haven Junction, Carbon Co., Pennsylvania. In Canada, an ore mineral in the Blind River-Elliot Lake district, Ontario, and at Eldorado, Saskatchewan. From Hornachuelos, Fuente Obejuna, and El Cabril, Cordoba, Spain. At Chateâu-Lambert, Voges, France. From Hüttenberg, Carinthia, Austria. Found at Lengenbach, Binntal, Valais, Switzerland. In Morocco, at Bou-Azzer. On the Witwatersrand, Transvaal, South Africa. From Crocker's Well, near Manna Hill, and the Nichols Nob copper mine, Flinders Range, South Australia. A few other localities are known.

**Name:** To honor Dr. John Casper Branner (1850–1922), American geologist, formerly Professor of Geology and President of Stanford University, Palo Alto, California, USA.

**Type Material:** National Museum of Natural History, Washington, D.C., USA, 105793, 114997.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 774–775. (2) Frondel, C. (1958) Systematic mineralogy of uranium and thorium. U.S. Geol. Sur. Bull. 1064, 333–337. (3) Hewett, D.F., J. Stone, and H. Levine (1957) Brannerite from San Bernardino County, California. Amer. Mineral., 42, 30–38. (4) Szymański, J.T. and J.D. Scott (1982) A crystal-structure refinement of synthetic brannerite, UTi<sub>2</sub>O<sub>6</sub>, and its bearing on rate of alkaline-carbonate leaching of brannerite in ore. Can. Mineral., 20, 271–279.