Dugganite $Pb_3(Zn,Cu)_3Te^{6+}O_6(AsO_4)(OH)_3$

Crystal Data: Hexagonal. *Point Group:* $6/m\ 2/m\ 2/m$. Crystals stubby prismatic, slightly curved, with {0001}, {$11\overline{2}0$}, {$11\overline{2}1$}, to 0.3 mm.

Physical Properties: *Cleavage:* {$11\overline{2}0$}, poor. *Fracture:* Brittle. Hardness = 3
D(meas.) = 6.33(15) D(calc.) = 6.33

Optical Properties: Semitransparent. *Color:* Colorless, water-green, yellow-green, may be zoned or sectored. *Streak:* White. *Luster:* Adamantine.
Optical Class: Uniaxial (–), anomalously slightly biaxial. $\omega = 1.977(2)$ $\epsilon = 1.967$
2V(meas.) = Small.

Cell Data: *Space Group:* $P6/mmm$. $a = 8.472(5)$ $c = 5.208(5)$ Z = 1

X-ray Powder Pattern: Tombstone, Arizona, USA.
3.284 (10), 2.997 (8), 2.446 (6), 1.896 (6), 1.603 (6), 2.773 (5), 1.177 (5)

Chemistry:

	(1)	(2)
TeO_3	14.0	14.26
As_2O_5	10.4	9.33
CuO	1.2	
ZnO	17.6	19.83
PbO	55.3	54.38
H_2O	1.5	2.20
Total	[100.0]	100.00

(1) Tombstone, Arizona, USA; average of four analyses for Pb, Zn, Cu, three for Te, and two for As, H_2O by the Penfield method; recalculated to 100% after deduction of insoluble 3.63% average.
(2) $Pb_3Zn_3(TeO_6)(AsO_4)(OH)_3$.

Occurrence: An alteration product of khinite and parakhinite, formed under acid oxidizing conditions from gold-telluride ores in massive vein quartz (Tombstone, Arizona, USA).

Association: Khinite, parakhinite, bromargyrite, chlorargyrite, cerussite, emmonsite, other tellurium oxysalts (Tombstone, Arizona, USA).

Distribution: In the USA, from the Emerald and Old Guard mines, and the Joe shaft, Tombstone, Cochise Co., Arizona; at the Centennial Eureka mine, Tintic district, Juab Co., Utah. From the Moctezuma (Bambolla) mine, 12 km south of Moctezuma, Sonora, Mexico.

Name: To honor Marjorie Duggan (1927–), American analytical chemist, who first analyzed Te^{6+} from nature.

Type Material: The Natural History Museum, London, England, 1980,544; Harvard University, Cambridge, Massachusetts, 119093; National Museum of Natural History, Washington, D.C., USA, 162207.

References: (1) Williams, S.A. (1978) Khinite, parakhinite, and dugganite, three new tellurates from Tombstone, Arizona. Amer. Mineral., 63, 1016–1019.