Turneaureite $Ca_5(AsO_4)_3Cl$

Crystal Data: Hexagonal. *Point Group*: 6/m. As prismatic crystals exhibiting {1010} and {0001}, to 1.5 mm; usually massive.

Physical Properties: *Fracture*: Uneven. Hardness = 5 D(meas.) = 3.60(5) D(calc.) = 3.63 Fluoresces bright orange under SW UV; may be phosphorescent.

Optical Properties: Translucent. *Color*: Colorless, grayish white. *Streak*: White. *Luster*: Vitreous to slightly greasy.
Optical Class: Uniaxial (–). ω = 1.708(3) ε = 1.700(3)

Cell Data: *Space Group*: $P6_3/m$. a = 9.9218(3) c = 6.8638(2) Z = 2

X-ray Powder Pattern: Långban, Sweden.
2.907 (100), 2.826 (90), 3.43 (60), 3.98 (50), 2.670 (50), 1.864 (40), 1.995 (30)

Chemistry:	(1)	(2)		(1)	(2)
P_2O_5	6.1	0.20	CaO	43.8	41.39
V_2O_5		0.01	SrO		0.12
As_2O_5	44.9	51.76	BaO		0.52
SO_3		0.22	F	1.2	0.32
SiO_2		0.06	Cl	3.2	2.56
Na_2O		0.02	H_2O	n.d	[0.58]
MnO	1.9	1.89	$-O=(F,Cl)_2$	1.2	0.71
PbO	0.7	0.10	Total	100.6	99.04

(1) Långban, Sweden; by electron microprobe, total Mn as MnO; corresponding to $(Ca_{4.85}Mn_{0.16}Pb_{0.02})_{\Sigma=5.03}[(AsO_4)_{2.42}(PO_4)_{0.54}]_{\Sigma=2.96}(Cl_{0.56}F_{0.39})_{\Sigma=0.95}$. (2) Brattfors mine, Nordmark, Värmland, Sweden; average of 10 electron microprobe analyses supplemented by FTIR spectroscopy, H_2O calculated so that (Cl+F+OH) = 1 apfu; corresponds to $(Ca_{4.82}Mn_{0.17}Ba_{0.02}Sr_{0.01})_{\Sigma=5.02}(As_{2.94}P_{0.02}S_{0.02}Si_{0.01})_{\Sigma=2.99}O_{12}[Cl_{0.47}(OH)_{0.42}F_{0.11}]_{\Sigma=1.00}$.

Mineral Group: Apatite group.

Occurrence: A rare component of manganiferous ores in high-grade marbles.

Association: Andradite, magnetite, calcite (Långban, Sweden); magnetite, andradite, manganoan calcite (Franklin, New Jersey, USA); donpeacorite, tirodite, ferrian braunite, dravite, anhydrite, manganoan dolomite (Fowler, New York, USA).

Distribution: From the Brattfors mine, Nordmark, (Långban), Värmland, Sweden. At Franklin, Sussex Co., New Jersey and in the Balmat #4 mine, Fowler, St. Lawrence Co., New York, USA.

Name: Honors Dr. Frederick Stewart Turneaure (1899-1986), Professor Emeritus of Geology, University of Michigan, Ann Arbor, Michigan, USA.

Type Material: Harvard University, Cambridge, Massachusetts (124237) and the National Museum of Natural History, Washington, D.C., USA (134981, C6270-1, C6270-2, 159862).

References: (1) Dunn, P.J., E.U. Petersen, and D.R. Peacor (1985) Turneaureite, a new member of the apatite group from Franklin, New Jersey, Balmat, New York and Långban, Sweden. Can. Mineral., 23, 251-254. (2) (1986) Amer. Mineral., 71, 1280 (abs. ref. 1). (3) Biagioni, C., F. Bosi, U. Hålenius, and M. Pasero (2017) The crystal structure of turneaureite, $Ca_5(AsO_4)_3Cl$, the arsenate analog of chlorapatite, and its relationships with the arsenate apatites johnbaumite and svabite. Amer. Mineral., 102, 1981-1986.