Graeserite $Fe_4Ti_3AsO_{13}(OH)$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. As acicular [001] crystals to 5 mm and as radial aggregates. *Twinning*: Along the elongation, common (lineations visible on crystals).

Physical Properties: *Cleavage*: Moderate on {100}. *Tenacity*: Ductile. *Fracture*: Conchoidal. Hardness = 5.5 VHN = 521 (25 g load). D(meas.) = n.d. D(calc.) = 4.56

Optical Properties: Opaque. *Color*: Black, grayish white in reflected light. *Streak*: Black. *Luster*: Metallic.
Optical Class: No pleochroism or bireflectance.
R_1-R_2: (460) 20.1-20.8, (480) 19.6-20.3, (540) 18.7-19.3, (580) 18.2-18.9, (660) 17.5-18.1

Cell Data: *Space Group*: *C*2/*m*. a = 5.006(2) b = 14.289(6) c = 7.184(2) β = 105.17(2)° Z = 2

X-Ray Diffraction Pattern: Monte Leone Nappe, Binntal Region, Western Alps, Switzerland. 2.681 (100), 2.846 (80), 1.5825 (50), 3.117 (30), 2.029 (30), 2.495 (20), 2.225 (20)

Chemistry:

	(1)	(2)		(1)	(2)
TiO_2	40.89	42.06	BaO		4.25
Fe_2O_3	33.64	23.26	As_2O_3	13.51	8.34
FeO	[3.94]	[6.95]	Sb_2O_3	1.43	7.47
Cr_2O_3		0.52	H_2O	[1.30]	[0.94]
V_2O_3		6.08	Total	99.80	100.33
PbO	5.00	0.37			

(1) Monte Leone Nappe, Binntal Region, Western Alps, Switzerland; average electron microprobe analysis, FeO and H_2O calculated; corresponds to $(Fe^{3+}_{2.91}Fe^{2+}_{0.38}Ti_{0.54}Pb_{0.15})_{\Sigma=3.98}Ti_3(As^{3+}_{0.94}Sb^{3+}_{0.07})_{\Sigma=1.01}O_{13}(OH)$. (2) Monte Arsiccio mine, Apuan Alps, Tuscany, Italy; average electron microprobe analysis supplemented by Mössbauer spectroscopy, H_2O calculated; corresponds to $Fe^{2+}_{0.68}(Fe^{3+}_{2.03}V_{0.57}Cr_{0.05})Ti_{3.68}(As^{3+}_{0.60}Sb^{3+}_{0.36})(Ba_{0.19}Pb_{0.01})O_{13.27}(OH)_{0.73}$.

Mineral Group: Derbylite group.

Occurrence: In hydrothermal Alpine-type fissures (Switzerland).

Association: Anatase, arsenopyrite, asbecasite, bournonite, cafarsite, cervandonite-(Ce), chernovite, fetiasite, gold (traces), hematite, magnetite, monazite-(Ce), rutile, tennantite (Switzerland); ankerite, arsenopyrite, baryte, bianchiniite, dolomite, galena, 'hyalophane', pyrite, quartz, rutile, siderite, sphalerite, stibivanite, 'tourmaline' (Italy).

Distribution: From the Monte Leone Nappe, Binntal Region, Western Alps, Switzerland (TL). From the Monte Arsiccio mine, Apuan Alps, Tuscany, Italy.

Name: Honors Professor Stefan *Graeser* (b. 1935) of the Mineralogical-Petrographic Institute, University of Basel, Switzerland for his research on oxides and sulfosalts of arsenic in the Binntal region.

Type Material: Natural History Museum, Basel, Switzerland.

References: (1) Krzemnicki, M.S. and E. Reusser (1998) Graeserite, $Fe_4Ti_3AsO_{13}(OH)$, a new mineral species of the derbylite group from the Monte Leone Nappe, Binntal Region, Western Alps, Switzerland. Can. Mineral., 36, 1083-1104. (2) Berlepsch, P. and T. Armbruster (1998) The crystal structure of Pb^{2+}-bearing graeserite, $Pb_{0.14}(Fe,Ti)_7AsO_{12+x}(OH)_{2-x}$, a mineral of the derbylite group. Schweiz. Mineral. Petrogr. Mitt., 78, 1-9. (3) (1999) Amer. Mineral., 84, 990-991 (abs. refs. 1 and 2). (4) Biagioni, C., E. Bonaccorsi, N. Perchiazzi, U. Hålenius, and F. Zaccarini (2020) Derbylite and graeserite from the Monte Arsiccio mine, Apuan Alps, Tuscany, Italy: occurrence and crystal-chemistry. Mineral. Mag., 84, 766-777.