Nataliakulikite $Ca_4Ti_2(Fe^{3+}, Fe^{2+})(Si, Fe^{3+}, Al)O_{11}$

Crystal Data: Orthorhombic. *Point Group*: 2/*m* 2/*m* 2/*m*. As subhedral or prismatic grains to 20 μm and their intergrowths to 50 μm.

Physical Properties: *Cleavage*: None. *Tenacity*: Brittle. *Fracture*: Uneven.
Hardness = ~5.5-6 VHN = 531 (20 g load). D(meas.) = n.d. D(calc.) = 4.006

Optical Properties: Opaque. *Color*: Brown, gray to light gray in reflected light with yellowish brown internal reflections. *Streak*: Light brown. *Luster*: Submetallic.
Optical Class: Bireflectance and anisotropy are weak. *Pleochroism*: Distinct, gray to light gray.
R_1-R_2: (470) 14.08-14.15, (546) 13.43-13.45, (589) 13.15-13.20, (650) 12.83-12.98

Cell Data: *Space Group: Pnma*. a = 5.254 b = 30.302 c = 5.488 Z = 4

X-Ray Diffraction Pattern: Nahal Morag Canyon, Negev desert, ~5 km southeast of Arad, Israel.
2.681 (100), 1.898 (30), 2.627 (26), 2.744 (23), 1.894 (22), 15.151 (19), 1.572 (14)

Chemistry:

	(1)	(2)		(1)	(2)
SiO_2	5.05	4.53	Fe_2O_3	[14.23]	15.07
TiO_2	29.04	30.14	FeO	[5.47]	5.42
ZrO_2	0.68		MnO	0.07	
Nb_2O_5	0.04		CaO	42.10	42.37
Cr_2O_3	0.08		SrO	0.27	
Al_2O_3	2.07	1.92	UO_2	0.20	.
			Total	99.30	99.45

(1) Nahal Morag Canyon, Negev desert, ~5 km southeast of Arad, Israel; average electron microprobe and Raman spectroscopic analyses, Fe^{3+}/Fe^{2+} for electroneutrality; corresponds to $(Ca_{3.992}Sr_{0.014}U_{0.004})(Ti_{1.933}Zr_{0.030}Nb_{0.002})(Fe^{3+}_{0.610}Fe^{2+}_{0.405}Cr_{0.005}Mn_{0.005})(Si_{0.447}Fe^{3+}_{0.337}Al_{0.216})O_{11}$.
(2) $Ca_4Ti_2(Fe^{3+}_{0.6}Fe^{2+}_{0.4})(Fe^{3+}_{0.4}Si_{0.4}Al_{0.2})O_{11}$.

Polymorphism & Series: Intermediate between perovskite and brownmillerite.

Mineral Group: Perovskite supergroup, non-stoichiometric perovskites group, brownmillerite subgroup.

Occurrence: In high-temperature, pyrometamorphic, larnite-gehlenite rock (HT-region of the spurrite-merwinite facies).

Association: Larnite, flamite, gehlenite, magnesioferrite, Fe^{3+}-rich perovskite, fluorapatite, baryte, hashemite, retrograde phases (afwillite, hillebrandite, portlandite, calcite, ettringite, hydrogarnet, other hydrated Ca-silicates).

Distribution: From the Nahal Morag Canyon, Negev desert, ~5 km southeast of Arad, Hatrurim Basin, Israel.

Name: Honors Russian mineralogist *Natalia* Artyemovna *Kulik* (b. 1933), Emeritus Professor of Mineralogy, Novosibirsk State University, an expert in mineralogical descriptions of granitic pegmatites, minerals of radioactive and rare-earth elements, and archaeometry.

Type Material: Central Siberian Geological Museum, V.S. Sobolev Institute of Geology and Mineralogy, Siberian Branch of the RAS, Novosibirsk, Russia (VII-101/1).

References: (1) Sharygin, V.V., G.A. Yakovlev, R. Wirth, Y.V. Seryotkin, E.V. Sokol, E.N. Nigmatulina, N.S. Karmanov, and L.A. Pautov (2019) Nataliakulikite, $Ca_4Ti_2(Fe^{3+},Fe^{2+})(Si,Fe^{3+},Al)O_{11}$, a new perovskite-supergroup mineral from Hatrurim Basin, Negev Desert, Israel. Minerals, 9, 700, 1-26.