Paragonite $NaAl_2(Si_3Al)O_{10}(OH)_2$

Crystal Data: Monoclinic; hexagonal in part. *Point Group:* $2/m$ or m. Crystals thin tabular ‖ {001}; commonly fine scaly, compact, massive. *Twinning:* By rotation of 180° about [310] or [3̄10].

Physical Properties: *Cleavage:* {001}, perfect. *Tenacity:* Flexible, elastic. Hardness = 2.5–3 D(meas.) = 2.85 D(calc.) = 2.907

Optical Properties: Transparent to translucent. *Color:* Colorless, pale yellow, grayish, grayish white, greenish, light apple-green; colorless in thin section, may show faint color tint. *Luster:* Pearly.
Optical Class: Biaxial (–). *Orientation:* $Y \simeq a$; $Z = b$; $X \wedge c \simeq 5°$. *Dispersion:* $r > v$. *Absorption:* Very faint; $Z \geq Y > X$. $\alpha = 1.564$–1.580 $\beta = 1.594$–1.609 $\gamma = 1.600$–1.609 2V(meas.) = 0°–40°

Cell Data: *Space Group:* $C2/c$ ($2M_1$). $a = 5.13(3)$ $b = 8.89(5)$ $c = 19.32(10)$ $\beta = 95°10(30)'$ Z = 4

X-ray Powder Pattern: Pizzo Forno, Switzerland; $2M_1$.
4.44 (100), 2.536 (90), 9.7 (80), 2.430 (80), 1.486 (80b), 2.921 (70), 2.831 (70)

Chemistry:	(1)	(2)		(1)	(2)		(1)	(2)
SiO_2	46.81	45.95	FeO		0.53	BaO		0.01
TiO_2		0.07	MnO		trace	Na_2O	6.40	7.39
Al_2O_3	40.06	40.47	MgO	0.65	0.13	K_2O		0.51
Fe_2O_3	trace		CaO	1.26	0.27	H_2O^+	4.82	[4.67]
						Total	100.00	[100.00]

(1) Pizzo Forno, Switzerland; corresponds to $(Na_{0.79}Ca_{0.09})_{\Sigma=0.88}(Al_{1.97}Mg_{0.06})_{\Sigma=2.03}(Si_{2.97}Al_{1.03})_{\Sigma=4.00}O_{10}(OH)_2$. (2) Zermatt-Saas region, Switzerland; by electron microprobe, average of four analyses, H_2O by difference; corresponding to $(Na_{0.92}K_{0.04}Ca_{0.02})_{\Sigma=0.98}(Al_{1.99}Fe_{0.03}Mg_{0.01})_{\Sigma=2.03}(Si_{2.94}Al_{1.06})_{\Sigma=4.00}O_{10}(OH)_2$.

Polymorphism & Series: $2M_1$, 3A polytypes.

Mineral Group: Mica group.

Occurrence: Uncommon, but may be in large amounts, in low- to medium-grade metamorphic schists and phyllites, in muscovite-biotite gneisses, quartz veins, fine-grained sediments, and glaucophane-bearing rocks.

Association: Kyanite, staurolite, muscovite, quartz, glaucophane, chlorite, garnet, tourmaline, calcite, actinolite.

Distribution: A few well-studied occurrences follow. On Pizzo Forno, Ticino, and in Val Täsch, Zermatt, Valais, Switzerland. From Prägraten, Tirol, Austria. At Ochsenkopf, Schwarzenberg, Saxony, Germany. In Italy, at Borgofrance, near Ivrea, Piedmont, and in the Pfitschtal, Trentino-Alto Adige. From Miass, Ilmen Mountains, Southern Ural Mountains, Russia. In the Ivigtut cryolite deposit, southwestern Greenland. In the USA, from Corundum Hill, Chester Co., Pennsylvania; in the Leadville district, Lake Co., Colorado.

Name: From the Greek, *paragon*, for *misleading*, as it looks like talc.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 623–624. (2) Deer, W.A., R.A. Howie, and J. Zussman (1963) Rock-forming minerals, v. 3, sheet silicates, 31–34. (3) Hildebrand, F.A. (1953) Minimizing the effects of preferred orientation in X-ray powder diffraction patterns. Amer. Mineral., 38, 1051–1056. (4) Zen, E-An, M. Ross, and P. Bearth (1964) Paragonite from Täsch Valley near Zermatt, Switzerland. Amer. Mineral., 49, 183–190. (5) Sidorenko, O.V., B.B. Zvyagin, and S.V. Soboleva (1977) The crystal structure of 3T paragonite. Kristallografiya (Sov. Phys. Crystal.), 22, 976–981 (in Russian). (6) Lin, C.-Y. and S.W. Bailey (1984) The crystal structure of paragonite-$2M_1$. Amer. Mineral., 69, 122–127.