Ardennite $\mathbf{Mn_4^{2+}(Al,Mg)_6(SiO_4)_2(Si_3O_{10})[(As,V)O_4](OH)_6}$

Crystal Data: Orthorhombic. *Point Group:* $2/m\ 2/m\ 2/m$. Individual crystals rare, prismatic, with prism faces strongly striated and pyramidal faces smooth; as radiating fibrous groups, to 4 cm.

Physical Properties: *Cleavage:* Perfect on {010}, distinct on {110}; parting on {001}. *Fracture:* Subconchoidal to uneven. *Tenacity:* Brittle. Hardness = 6–7 D(meas.) = 3.69–3.75 D(calc.) = 3.74

Optical Properties: Nearly opaque, translucent in thin fragments. *Color:* Yellow to yellowish brown; in thin section, yellow to brown. *Luster:* Subadamantine.
Optical Class: Biaxial (+). *Pleochroism:* Strong; X = dark brownish yellow; Y = golden yellow; Z = pale yellow. *Orientation:* $Z = b$ or c. α = n.d. β = 1.74–1.78; birefringence = 0.15–0.20. γ = n.d. 2V(meas.) = 0°–70°

Cell Data: *Space Group: Pnmm.* $a = 8.7126(8)$ $b = 18.5124(11)$ $c = 5.8108(8)$ Z = 2

X-ray Powder Pattern: Salmchâteau, Belgium.
2.574 (100), 2.911 (70), 4.21 (60), 3.15 (60), 2.871 (60), 1.448 (60), 3.76 (50)

Chemistry:

	(1)	(2)		(1)	(2)
SiO_2	27.85	29.70	MnO	25.70	18.93
TiO_2		0.04	CuO	0.26	0.01
Al_2O_3	23.55	22.99	MgO	2.30	5.49
Fe_2O_3	0.86	2.77	CaO	1.17	4.41
As_2O_5	13.25	10.11	H_2O^+	5.10	5.44
V_2O_5	0.89	0.04	H_2O^-	0.02	
FeO	0.00		Total	100.95	99.93

(1) Salmchâteau, Belgium. (2) Haute-Maurienne, France; by electron microprobe, confirmed by XRF and wet analysis, H_2O by coulometry; corresponds to $(Mn^{2+}_{2.75}Ca_{0.81}Mg_{0.43})_{\Sigma=3.99}(Al_{4.65}Mg_{0.98}Fe^{3+}_{0.36})_{\Sigma=5.99}(As_{0.91}O_4)Si_{5.10}O_{18}(OH)_6$.

Occurrence: In pegmatites and quartz veins in schist (Salmchâteau, Belgium); in highly oxidized Mn, Al-rich metasediments (Andros Island, Greece).

Association: Quartz, albite, pyrolusite, piemontite, spessartine, braunite, hematite.

Distribution: At Salmchâteau, near Ottré, and at Bihain, Belgium. From Ala, Piedmont, Italy. At Bonneval-sur-Arc, Haute-Maurienne, Isère, France. In the Merehead quarry, Shepton Mallet, Somerset, England. On Evvia and Andros Islands, Cyclades Islands, Greece. At the Kajlidongri manganese mine, Jhabua district, Madhya Pradesh, India. Along the Asemi-gawa River, Kochi Prefecture, Japan.

Name: For the initial occurrence at Salmchâteau, in the Ardennes Mountains, Belgium.

References: (1) Dana, E.S. (1892) Dana's system of mineralogy, (6th edition), 542–543. (2) Moore, P.B. (1965) Cell data of orientite and its relation to ardennite and zoisite. Can. Mineral., 8, 262–265. (3) Donnay, G. and R. Allmann (1968) Si_3O_{10} groups in the crystal structure of ardennite. Acta Cryst., 24, 845–855. (4) Allman, R. and G. Donnay (1971) Structural relations between pumpellyite and ardennite. Acta Cryst., 27, 1871–1875. (5) Pasero, M. and T. Reinecke (1991) Crystal chemistry, HRTEM analysis and polytypic behavior of ardennite. Eur. J. Mineral., 3, 819–830.