Creedite $Ca_3Al_2(SO_4)(F,OH)_{10}\cdot 2H_2O$

Crystal Data: Monoclinic. *Point Group:* $2/m$. Crystals are prismatic [001], bladelike to acicular, typically with {110}, {111}, {$\bar{1}$11}, {001}, several other minor forms noted, to 8 cm; radiating, drusy to granular aggregates.

Physical Properties: *Cleavage:* {100}, perfect. *Fracture:* Conchoidal. *Tenacity:* Brittle. Hardness = 4 D(meas.) = 2.713–2.730 D(calc.) = 2.739

Optical Properties: Transparent to translucent. *Color:* Colorless to white, purple; colorless in transmitted light. *Luster:* Vitreous.
Optical Class: Biaxial (–). *Orientation:* $Y = b$; $Z \wedge c = 42.5°$. *Dispersion:* $r > v$, strong.
$\alpha = 1.461(1)$ $\beta = 1.478(1)$ $\gamma = 1.485(1)$ 2V(meas.) = 64°22′ 2V(calc.) = 65°

Cell Data: *Space Group:* $C2/c$. $a = 13.936(1)$ $b = 8.606(1)$ $c = 9.985(1)$ $\beta = 94.39(1)°$
Z = 4

X-ray Powder Pattern: Wagon Wheel Gap, Colorado, USA.
3.48 (10), 7.3 (9), 6.9 (9), 3.92 (9), 2.161 (9), 5.79 (8), 3.07 (8)

Chemistry:

	(1)
SO_4	19.10
Al_2O_3	21.42
CaO	35.18
F	30.30
H_2O	10.72
$-O = F_2$	17.28
Total	99.44

(1) Wagon Wheel Gap, Colorado, USA; H_2O by the Penfield method, corresponds to $Ca_{2.99}Al_{2.19}(SO_4)_{1.00}[F_{8.02}(OH)_{2.00}]_{\Sigma=10.02}\cdot 2.06H_2O$.

Occurrence: Uncommon in fluorite-rich hydrothermal mineral deposits.

Association: Fluorite, barite, kaolinite (Wagon Wheel Gap, Colorado, USA).

Distribution: In the USA, from Wagon Wheel Gap, near Creede, Mineral Co., Colorado; in the Liberty and Hall mines and at Granite, near Tonopah, Nye Co., Nevada; in Arizona, at the Grand Reef mine, Graham Co.; from the Thompson and Defiance mines, Darwin district, Inyo Co., California. In Mexico, large crystals from the Potosí and other mines, Santa Eulalia district, Chihuahua. Exceptional crystals from Colquiri, La Paz, Bolivia. In the Dzhaambai deposit, eastern Pamir Mountains, Tajikistan. Fine examples from Aktshatau, 40 km south of Dzhezkazgan, Kazakhstan. Several other minor localities are known.

Name: For the occurrence near Creede, Colorado, USA.

Type Material: Harvard University, Cambridge, Massachusetts, 81273; National Museum of Natural History, Washington, D.C., USA, 93117, C1034.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 129–130. (2) Giuseppetti, G. and C. Tadini (1983) Structural analysis and refinement of Bolivian creedite, $Ca_3Al_2F_8(OH)_2(SO_4)\cdot 2H_2O$. Neues Jahrb. Mineral., Monatsh., 69–78. Navidad mine, Rodeo, Durango, Mexico - 1 cm - Sink; (3) Fleischer, M. (1952) Probable identity of belyankite with creedite. Amer. Mineral., 37, 785–790. (4) Foshag, W.F. (1922) The crystallography and chemical composition of creedite, Proc. U.S. National Museum, 59, 419–424.