Nolanite $(V^{3+}, Fe^{3+}, Fe^{2+}, Ti)_{10}O_{14}(OH)_2$

Crystal Data: Hexagonal. *Point Group:* $6mm$. As euhedral hexagonal plates, to 1 mm, exhibiting {0001}, $\{10\bar{1}0\}$, and $\{10\bar{1}1\}$; as exsolution lamellae in vanadian magnetite; commonly aggregated into crusts and massive vein fillings.

Physical Properties: Hardness = ~5 VHN = 710–760, 734 average (20 g load).
D(meas.) = 4.65 D(calc.) = 4.60

Optical Properties: Opaque, slightly translucent in thin fragments. *Color:* Black; dark gray to dark grayish violet in reflected light. *Streak:* Brownish black. *Luster:* Submetallic.
Optical Class: Uniaxial. *Pleochroism:* Dark brown to deep blue. *Anisotropism:* Moderate; light to dark gray.
R_1–R_2: (470) 11.0–12.7, (546) 11.8–13.5, (589) 12.3–14.0

Cell Data: *Space Group:* $P6_3mc$. $a = 5.846$–5.897 $c = 9.254$–9.295 $Z = 1$

X-ray Powder Pattern: Saskatchewan, Canada.
3.44 (100), 2.66 (90), 2.49 (90), 1.495 (60), 4.66 (55), 2.23 (50), 2.46 (40)

Chemistry:

	(1)	(2)
Ti	3.7	6.7
V	45.0	33.5
Al	0.9	0.8
Fe	15.9	24.0
Mn	< 0.1	0.1
Mg	< 0.1	0.1
Na	0.1	0.2
Total		

(1–2) Kalgoorlie, Western Australia; by electron microprobe; V and Fe valences and $(OH)^{1-}$ from crystal structure determinations, corresponding respectively to $(V^{3+}_{6.9}Fe^{3+}_{1.6}Fe^{2+}_{0.6}Ti_{0.6}Al_{0.3})_{\Sigma=10.0}O_{14}(OH)_2$ and $(V^{3+}_{5.2}Fe^{3+}_{2.4}Fe^{2+}_{1.1}Ti_{1.1}Al_{0.2})_{\Sigma=10.0}O_{14}(OH)_2$.

Occurrence: In hydrothermal uranium deposits (Saskatchewan, Canada); in gold deposits in metamorphosed greenstones (Kalgoorlie, Western Australia).

Association: Dolomite, calcite, quartz, uraninite, pyrite, chalcopyrite, galena, ilmenite, hematite, carnotite (Saskatchewan, Canada); gold, gold tellurides, vanadian muscovite, tourmaline, tivanite, vanadian hematite, vanadian magnetite (Kalgoorlie, Western Australia).

Distribution: From Fish-Hook Bay, Lake Athabaska, and at the Ace mine, the Consolidated Nicholson Mine No. 2, and the Pitche claims, Beaverlodge Lake, Saskatchewan, Canada. From Wild Steer Canyon, Paradox Valley, Montrose Co., Colorado, and in the Campbell mine, Bisbee, Cochise Co., Arizona, USA. In several mines at Kalgoorlie, Western Australia. From the Mounana uranium mine, Franceville, Gabon.

Name: To honor Dr. Thomas Brennan Nolan (1901–1992), formerly Director of the U.S. Geological Survey, Washington, D.C., USA.

Type Material: The Natural History Museum, London, England, 1965,206; National Museum of Natural History, Washington, D.C., USA, 112965.

References: (1) Robinson, S.C., H.T. Evans, Jr., W.T. Schaller, and J.J. Fahey (1957) Nolanite, a new iron-vanadium mineral from Beaverlodge, Saskatchewan. Amer. Mineral., 42, 619–628. (2) Gatehouse, B.M., I.E. Gray, and E.H. Nickel (1983) The crystal chemistry of nolanite, $(V, Fe, Ti, Al)_{10}O_{14}(OH)_2$, from Kalgoorlie, Western Australia. Amer. Mineral., 68, 833–839.