## Davidbrownite-($NH_4$) $(NH_4, K)_5(V^{4+}O)_2(C_2O_4)[PO_{2.75}(OH)_{1.25}]_4 \cdot 3H_2O$

**Crystal Data**: Monoclinic. *Point Group*: 2/*m*. Typically, in sprays of needles or narrow blades to ~0.2 mm elongate along [010] and flattened on {100}, that exhibit {100}, {001} and {230}.

**Physical Properties**: *Cleavage*: Two good in the [010] zone, probably {100} and {001}. *Tenacity*: Brittle. *Fracture*: Splintery. Hardness = ~2 D(meas.) = 2.12(2) D(calc.) = 2.116 Nonfluorescent. Easily soluble in dilute HCl.

**Optical Properties**: Transparent. *Color*: Light green-blue. *Streak*: White. *Luster*: Vitreous. *Optical Class*: Biaxial (+). $\alpha = 1.540(2)$ $\beta = 1.550(5)$ $\gamma = 1.582(2)$ 2V(meas.) = 58.5(5)° 2V(calc.) = 59.4° *Dispersion*: Moderate, $r > v$. *Orientation*: $Z = b$, $Y \approx a$. *Pleochroism*: $X$ = pale blue, $Y$ = nearly colorless, $Z$ = light blue. *Absorption*: $Y < X < Z$.

**Cell Data**: *Space Group: $P2_1/c$*. $a = 10.356(6)$ $b = 8.923(5)$ $c = 13.486(7)$ $\beta = 92.618(9)°$ $Z = 2$

**X-Ray Diffraction Pattern**: Rowley mine, Maricopa Co., Arizona, USA.
10.39 (100), 6.73 (50), 3.160 (47), 2.977 (44), 3.104 (42), 3.789 (35), 3.043(35)

**Chemistry**:

| | (1) | (2) |
|---|---|---|
| $(NH_4)_2O$ | 10.47 | 9.85 |
| $K_2O$ | 10.54 | 11.88 |
| $Na_2O$ | 0.35 | |
| MgO | 0.05 | |
| $Al_2O_3$ | 0.12 | |
| $VO_2$ | 20.60 | 20.91 |
| $P_2O_5$ | 36.17 | 35.79 |
| $As_2O_5$ | 1.76 | |
| $C_2O_3$ | [9.33] | 9.08 |
| $H_2O$ | [12.90] | 12.49 |
| Total | 102.29 | 100.00 |

(1) Rowley mine, Maricopa Co., Arizona, USA; average electron microprobe and IR spectroscopic analyses, C and H content calculated from structure; corresponding to $[(NH_4)_{3.11}K_{1.73}Na_{0.09}]_{\Sigma=4.93}[(V^{4+}{}_{1.92}Mg_{0.01}Al_{0.02})_{\Sigma=1.95}O_2](C_2O_4)[(P_{3.94}As_{0.12})_{\Sigma=4.06}O_{10.94}(OH)_{5.06}]\cdot 3H_2O$.
(2) $[(NH_4)_3K_2](V^{4+}O)_2(C_2O_4)[PO_{2.75}(OH)_{1.25}]_4\cdot 3H_2O$.

**Occurrence**: In a bat-guano-related, post-mining assemblage in a hot and humid area of the mine.

**Association**: Antipinite, fluorite, mimetite, mottramite, quartz, rowleyite, salammoniac, struvite, vanadinite, willemite, wulfenite.

**Distribution**: At the Rowley mine (125-foot level), ~20 km northwest of Theba, Maricopa Co., Arizona, USA.

**Name**: Honors British-Canadian crystallographer Dr. I. *David Brown* (b. 1932) for developing Bond-Valence Theory, now used extensively by mineralogical crystallographers to both validate structural arrangements and to derive crystal-chemical details (e.g., the presence of hydrogen and its speciation in structures and the arrangements of hydrogen bonds) that are not revealed directly by crystal-structure refinement. The suffix indicates $(NH_4)^+ > K^+$.

**Type Material**: Natural History Museum of Los Angeles County, Los Angeles, California, USA (66951, 66955 and 66959).

**References**: (1) Kampf, A.R., M.A. Cooper, G.R. Rossman, B.P. Nash, F.C. Hawthorne, and J. Marty (2019) Davidbrownite-($NH_4$), $(NH_4,K)_5(V^{4+}O)_2(C_2O_4)[PO_{2.75}(OH)_{1.25}]_4\cdot 3H_2O$, a new phosphate-oxalate mineral from the Rowley mine, Arizona, USA. Mineral. Mag., 83, 869-877.