

Nitscheite, $(\text{NH}_4)_2[(\text{UO}_2)_2(\text{SO}_4)_3(\text{H}_2\text{O})_2] \cdot 3\text{H}_2\text{O}$, a new mineral with an unusual uranyl-sulfate sheet

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ABSTRACT

Nitscheite (IMA2020-078), $(\text{NH}_4)_2[(\text{UO}_2)_2(\text{SO}_4)_3(\text{H}_2\text{O})_2] \cdot 3\text{H}_2\text{O}$, is a new mineral species from the Green Lizard mine, Red Canyon, San Juan County, Utah, U.S.A. It is a secondary phase found in association with chinleite-(Y), gypsum, pyrite, and Co-rich rietveldite. Nitscheite occurs in subparallel and divergent intergrowths of yellow prisms, up to about 0.3 mm in length. Crystals are elongated on [101] and exhibit the forms {100}, {010}, {001}, and {11 $\bar{1}$ }. The mineral is transparent with vitreous luster and very pale-yellow streak. It exhibits bright green fluorescence under a 405 nm laser. The Mohs hardness is ~2. The mineral has brittle tenacity, curved fracture, and one good cleavage on {010}. The measured density is 3.30(2) g·cm⁻³. The mineral is easily soluble in H₂O at room temperature. The mineral is optically biaxial (-), $\alpha = 1.560(2)$, $\beta = 1.582(2)$, $\gamma = 1.583(2)$ (white light); $2V_{\text{meas}} = 17(1)^\circ$; no dispersion; orientation $X = \mathbf{b}$, $Z \approx [101]$; pleochroism X colorless, Y and Z yellow; $X < Y \approx Z$. Electron microprobe analysis provided the empirical formula $(\text{NH}_4)_{1.99}\text{U}_{2.00}\text{S}_{3.00}\text{O}_{21}\text{H}_{10.01}$. Nitscheite is monoclinic, $P2_1/n$, $a = 17.3982(4)$, $b = 12.8552(3)$, $c = 17.4054(12)$ Å, $\beta = 96.649(7)^\circ$, $V = 3866.7(3)$ Å³, and $Z = 8$. The structure ($R_1 = 0.0329$ for 4547 $I > 3\sigma I$ reflections) contains $[(\text{UO}_2)_2(\text{SO}_4)_3(\text{H}_2\text{O})_2]^{2-}$ uranyl-sulfate sheets, which are unique among minerals, with NH₄ and H₂O groups between the sheets.

Keywords: Nitscheite, new mineral, uranyl-sulfate sheet, crystal structure, Raman spectroscopy, Green Lizard mine, Red Canyon, Utah