

Nickel-zippeite

$\text{Ni}_2(\text{UO}_2)_6(\text{SO}_4)_3(\text{OH})_{10} \cdot 16\text{H}_2\text{O}$

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Crystal Data: Orthorhombic (?). *Point Group:* n.d. Very fine grained, in crusts and coatings. *Twinning:* Common on $\{h0l\}$ with symmetrical extinction $Z \wedge Z' \simeq 28^\circ$; may be polysynthetic or as fourlings, with extinction $Y \wedge Y' \simeq 74^\circ$.

Physical Properties: *Cleavage:* Perfect to $\{010\}$; perhaps another, inclined (synthetic). Hardness = ~ 2 (synthetic). $D(\text{meas.}) = > 3.3$ $D(\text{calc.}) = \text{n.d.}$ Radioactive; fluoresces bright yellow under SW and LW UV.

Optical Properties: Semitransparent. *Color:* Tan to brownish yellow, yellow-orange. *Optical Class:* Biaxial (+) (synthetic). *Pleochroism:* $X = \text{colorless to pale yellow}$; $Y = \text{yellow}$; $Z = \text{dark yellow to golden yellow}$. *Orientation:* $Z = c$. $\alpha = 1.73\text{--}1.74$ $\beta = 1.76\text{--}1.77$ $\gamma = 1.82\text{--}1.83$ $2V(\text{meas.}) = \text{Moderate to large}$.

Cell Data: *Space Group:* n.d. $Z = \text{n.d.}$

X-ray Powder Pattern: Happy Jack mine, Utah, USA; nearly identical to cobalt-zippeite. 3.45 (100), 7.10 (93), 3.10 (67), 3.56 (42), 9.63 (37), 2.481 (31), 2.644 (30)

Chemistry:	(1)	(2)
SO_3	10.56	9.67
UO_3	66.1	69.09
FeO	0.70	
MnO	0.33	
CoO	1.33	
NiO	2.14	6.01
MgO	0.54	
H_2O	18.1	15.23
Total	[99.8]	100.00

(1) Happy Jack mine, Utah, USA; recalculated after deduction of SiO_2 1.23%, Al_2O_3 0.5%, TiO_2 0.08%, $(\text{Ce}, \text{Y})_2\text{O}_3$ 0.41%; corresponds to $(\text{Ni}_{0.78}\text{Co}_{0.48}\text{Mg}_{0.36}\text{Fe}_{0.26}\text{Mn}_{0.12})_{\Sigma=2.00}(\text{UO}_2)_6(\text{SO}_4)_3(\text{OH})_{10} \cdot 16\text{H}_2\text{O}$. (2) $\text{Ni}_2(\text{UO}_2)_6(\text{SO}_4)_3(\text{OH})_{10} \cdot 16\text{H}_2\text{O}$.

Occurrence: Typically as secondary coatings on mine walls, derived from oxidation of uranium-bearing primary Ni-Co sulfides.

Association: Cobalt-zippeite, sodium-zippeite, zippeite, johannite, uranopilite, zeunerite, schröckingerite, bayleyite, chalcantite, antlerite, siderotil, bieberite, erythrite, epsomite, gypsum, uraninite.

Distribution: In the USA, from the Happy Jack mine, White Canyon, San Juan Co., and at Castleton, La Sal Mountains, Grand Co., Utah; in the Hillside mine, about 5.5 km north of Bagdad, Eureka district, Yavapai Co., Arizona. From Great Bear Lake, Northwest Territories, Canada. At Jáchymov (Joachimsthal), Czech Republic.

Name: For its dominant content of *nickel* and relation to other *zippeite* group species.

Type Material: n.d.

References: (1) Frondel, C., J. Ito, R.M. Honea, and A.M. Weeks (1976) Mineralogy of the zippeite group. *Can. Mineral.*, 14, 429–436. (2) Haacke, D.F. and P.A. Williams (1979) The aqueous chemistry of uranium minerals. Part I. Divalent cation zippeite. *Mineral. Mag.*, 43, 539–541.