Zippeite $K_2[(UO_2)_4(SO_4)_2O_2(OH)_2](H_2O)_4$

Crystal Data: Monoclinic, pseudo-orthorhombic. *Point Group*: 2/*m*. Rare crystals are rhomboidal or platy on {010}, elongated along [001], to 0.5 mm; in radial or vermicular aggregates, earthy efflorescences, powdery coatings, and crusts. *Twinning*: Probable, observed in synthetic material.

Physical Properties: Hardness = ~2 D(meas.) = 4.8 D(calc.) = 4.66 Radioactive; commonly fluoresces yellow-green to green under SW and LW UV.

Optical Properties: Semitransparent. *Color*: Deep yellow, yellow-orange, red, brownish yellow, brownish orange. *Luster*: Vitreous.
Optical Class: Biaxial (–) (synthetic). α = 1.625(1) β = 1.710(2) γ = 1.740(2) 2V(meas.) = Large. 2V(calc.) = 59° *Pleochroism*: *X* = nearly colorless; *Y* = pale yellow to yellow-orange; *Z* = deep yellow to yellow-orange.

Cell Data: *Space Group*: *C*2/*m*. *a* = 8.7802(6) *b* = 13.9903(12) *c* = 8.8630(6) β = 104.524(7)° Z = 2

X-ray Powder Pattern: Jáchymov, Czech Republic.
7.06 (10), 3.50 (9), 3.12 (8), 2.87 (4), 2.65 (4), 2.22 (4), 5.45 (3)

Chemistry:

	(1)		(1)
SO_3	10.24	CoO	0.07
SiO_2	0.51	Na_2O	0.03
UO_3	80.12	K_2O	5.48
FeO	0.19	H_2O	[6.01]
CaO	0.09	Total	102.74

(1) Jáchymov, Czech Republic; average of 4 electron microprobe analyses, H_2O calculated from structure and for charge balance; corresponds to $(K_{1.73}Fe_{0.04}Ca_{0.02}Na_{0.02}Co_{0.01})_{\Sigma=1.82}[(UO_2)_{4.16}O_2(OH)_{1.91}(SO_4)_{1.90}(SiO_4)_{0.13}]_{\Sigma=2.03}](H_2O)_4$.

Occurrence: An uncommon secondary mineral, in part post-mine, in oxidized uranium deposits.

Association: Uranopilite, natrozippeite, nickelzippeite, magnesiozippeite, johannite, uranophane, schröckingerite, gypsum.

Distribution: From Jáchymov (Joachimsthal), Czech Republic. At Nowa Ruda, Lower Silesia, Poland. In England, from Cornwall, at the Gunnislake mine, Calstock; the South Terras mine, St. Stephen-in-Brannel; the Carharrack mine, St. Day; Wheal Buller, Redruth; Wheal Edward and Wheal Owles, St. Just. From the USA, in Colorado, at the Diamond Joe and Remington mines, Idaho Springs district, Clear Creek Co., and in the Telegraph, Wood, and Kirk mines, Gilpin Co.; at the Apex mine, Reese River district, Lander Co., Nevada; in Arizona, from the Hillside mine, about 5.5 km north of Bagdad, Eureka district, Yavapai Co., in the Monument No. 1 and Mitten No. 2 mines, Navajo Co., and at the Huskon No. 7 and No. 8 claims, and the Sun Valley mine, in the Cameron area, Coconino Co. Other localities are probable but require modern confirmation.

Name: Honors Dr. František Xaver Maximillian *Zippe* (1791-1863), Austrian mineralogist and geologist.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 598-599. (2) Frondel, C., J. Ito, R.M. Honea, and A.M. Weeks (1976) Mineralogy of the zippeite group. Can. Mineral., 14, 429-436. (3) Vochten, R., L. Van Haverbeke, K. Van Springel, N. Blaton, and O.M. Peeters (1995) The structure and physicochemical characteristics of synthetic zippeite. Can. Mineral., 33, 1091-1101. (4) Ondruš, P., F. Veselovský, J. Hloušek, R. Skála, I. Vavřín, J. Frýda, J. Cejka, and A. Gabašová (1997) Secondary minerals of the Jáchymov (Joachimsthal) ore district. J. Czech Geol. Soc., 42(4), 3-76, esp. 57-58. (5) Burns, P.C., K.M. Deely, and L.A. Hayden (2003) The crystal chemistry of the zippeite group. Can. Mineral., 41, 687-706. (6) Plášil, J., S.J. Mills, K. Fejfarová, M. Dušek, M. Novák, R. Škoda, J. Čejka, and J. Sejkora (2011) The crystal structure of natural zippeite, $K_{1.85}H^+_{0.15}[(UO_2)_4O_2(SO_4)_2(OH)_2](H_2O)_4$, from Jáchymov, Czech Republic. Can. Mineral., 49(4), 1089-1103.