Rietveldite $Fe(UO_2)(SO_4)_2 \cdot 5H_2O$

Crystal Data: Orthorhombic. *Point Group*: *mm*2. As subparallel intergrowths or random sprays of crystals elongated along [001] and flattened on (010) to 0.5 mm.

Physical Properties: *Cleavage*: Good on {010}, fair on {100} and {001}. *Tenacity*: Brittle. *Fracture*: Curved. Hardness = ~ 2 D(meas.) = 3.31 D(calc.) = 3.274 Soluble in water.

Optical Properties: Transparent. *Color*: Brownish yellow; yellowish beige (aggregates). *Streak*: White. *Luster*: Vitreous.
Optical Class: Biaxial (+). $\alpha = 1.570$ $\beta = 1.577$ $\gamma = 1.586$ 2V(meas.) = 82(1)°
2V(calc.) = 83.3° *Pleochroism*: Very weak, shades of light brownish yellow.
Absorption: $Y < X \approx Z$. *Orientation*: $X = b$, $Y = a$, $Z = c$. *Dispersion:* Very strong, $r > v$.

Cell Data: *Space Group*: $Pmn2_1$. $a = 12.9577(9)$ $b = 8.3183(3)$ $c = 11.2971(5)$ Z = 4

X-ray Powder Pattern: Jáchymov, Czech Republic.
6.477 (100), 5.110 (58), 3.238 (49), 4.668 (48), 3.428 (41), 4.653 (36), 8.309 (34)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
FeO	9.56	9.02	10.34	SO_3	26.99	25.39	26.46
ZnO	1.06		0.61	UO_3	47.32	46.62	47.39
MgO	0.14	0.48	0.06	H_2O	[15.39]	[15.80]	[14.75]
MnO	0.10	2.32	0.36	Total	100.56	99.63	99.97

(1) Giveaway-Simplot mine, Utah, USA; average of 4 electron microprobe analyses supplemented by Raman and IR spectroscopy, H_2O from structure analysis; corresponds to $(Fe_{0.79}Zn_{0.08}Mg_{0.02}Mn_{0.01})_{\Sigma=0.90}(UO_2)_{0.99}(SO_4)_{2.01} \cdot 5.10H_2O$. (2) Willi Agatz mine, Saxony, Germany; average of 6 electron microprobe analyses supplemented by Raman and IR spectroscopy, H_2O from structure analysis; corresponds to $(Fe_{0.76}Mn_{0.20}Mg_{0.07})_{\Sigma=1.03}(UO_2)_{0.98}(SO_4)_{1.91} \cdot 5.29H_2O$. (3) Jáchymov, Czech Republic; average of 7 electron microprobe analyses supplemented by Raman and IR spectroscopy, H_2O from structure; corresponds to $(Fe_{0.88}Zn_{0.05}Mn_{0.03}Mg_{0.01})_{\Sigma=0.97}(UO_2)_{1.01}(SO_4)_{2.01} \cdot 4.98H_2O$.

Occurrence: A result of oxidation in a humid, postmining, underground environment, attacking disseminations of uraninite and pyrite originally deposited as replacements of wood and other organic material in permeable sandstone (Utah); weathering product of U-bearing pyritiferous coal (Germany); on a museum specimen of strongly altered gangue (Czech Republic).

Association: Asphaltum, ferricopiapite, gypsum, römerite, shumwayite, halotrichite (Utah); halotrichite, krausite, melanterite, native sulfur, voltaite (Germany); rozenite, shumwayite, and an unnamed Al-uranyl sulfate (Czech Republic).

Distribution: Found at the Giveaway-Simplot mine, White Canyon mining district, San Juan Co., Utah, USA, at the Willi Agatz mine, Gittersee mining field, Dresden, Saxony, Germany, and at Jáchymov, Western Bohemia, Czech Republic.

Name: Honors Dutch crystallographer Hugo M. Rietveld (1932-2016) the author of the Rietveld method for the refinement of neutron and powder X-ray diffraction data. He was involved in the study of uranium compounds for much of his scientific career.

Type Material: Natural History Museum of Los Angeles County, Los Angeles, California, USA (66291, 66292); the TU Bergakademie, Freiberg, Germany (84140); and the National Museum, Prague, Czech Republic (PIN 45564).

References: (1) Kampf, A.R., J. Sejkora, T. Witzke, J. Plášil, J. Čejka, B.P. Nash, and J. Marty (2017) Rietveldite, $Fe(UO_2)(SO_4)_2(H_2O)_5$, a new uranyl sulfate mineral from Giveaway-Simplot mine (Utah, U.S.A.), Willi Agatz mine (Saxony, Germany) and Jáchymov (Czech Republic). Journal of Geosciences, 62(2), 107-120. (2) (2018) Amer. Mineral., 103, 2530 (abs. ref. 1).