Markeyite $Ca_9(UO_2)_4(CO_3)_{13}\cdot 28H_2O$

Crystal Data: Orthorhombic. *Point Group*: 2/*m* 2/*m* 2/*m*. As blades and tablets, to ~1 mm, flattened on {001} and elongated along [010] that display {100}, {010}, {001}, {110}, {101}, {011} and {111}.

Physical Properties: *Cleavage*: Perfect on {001}, good on {100} and {010}. *Fracture*: Irregular. *Tenacity*: Brittle. Hardness = 1.5-2 D(meas.) = 2.68 D(calc.) = 2.699 Fluoresces bright bluish white under a 405 nm laser. Dissolves very slowly in H_2O (minutes) and dissolves immediately with effervescence in dilute HCl.

Optical Properties: Transparent. *Color*: Pale yellowish green. *Streak*: White. *Luster*: Vitreous. *Optical Class*: Biaxial (–). α = 1.538(1) β = 1.542(1) γ = 1.545(1) 2V(meas.) = 81(2)° 2V(calc.) = 81.6° *Dispersion*: $r < v$, weak. *Pleochroism*: X = light greenish yellow, $Y \approx Z$ = light yellow. *Absorption*: $X > Y \approx Z$. *Orientation*: $X = c$, $Y = b$, $Z = a$.

Cell Data: Space Group: *Pmmn*. a = 17.9688(13) b = 18.4705(6) c = 10.1136(4) Z = 2

X-ray Powder Pattern: Markey mine, Red Canyon, San Juan County, Utah, USA.
5.43 (100), 6.41 (91), 10.12 (69), 4.104 (37), 3.984 (34), 5.07 (33), 4.618 (25)

Chemistry:

	(1)	(2)
CaO	18.60	18.52
UO_3	42.90	41.98
CO_2	[21.30]	20.99
H_2O	[18.78]	18.51
Total	101.58	100.00

(1) Markey mine, Red Canyon, San Juan County, Utah, USA; average of 9 EDS analyses supplemented with Raman spectroscopy, H_2O and CO_2 calculated from stoichiometry; corresponds to $Ca_{8.91}(U_{1.01}O_2)_4(CO_3)_{13}\cdot 28H_2O$. (2) $Ca_9(UO_2)_4(CO_3)_{13}\cdot 28H_2O$.

Occurrence: As efflorescent crusts on the surfaces of mine walls in a Colorado Plateau-type, roll front uranium deposit.

Association: Asphaltum, calcite, gypsum, natrozippeite.

Distribution: In the Markey mine, Red Canyon, White Canyon District, San Juan County, Utah, USA.

Name: For the locality, the *Markey* mine.

Type Material: Natural History Museum of Los Angeles County, Los Angeles, California, USA (67091, 67092, 67093, 67094 and 69095) and the A.E. Fersman Mineralogical Museum, Russian Academy of Sciences, Moscow, Russia (4932/1).

References: (1) Kampf, A.R., J. Plášil, A.V. Kasatkin, J. Marty, and J. Čejka (2018) Markeyite, a new calcium uranyl carbonate mineral from the Markey mine, San Juan County, Utah, USA. Mineral. Mag., 82(5), 1089-1100. (2) (2019) Amer. Mineral., 104(5), 781-782 (abs. ref 1).