Zaccagnaite $Zn_4Al_2(OH)_{12}(CO_3)\cdot 3H_2O$

Crystal Data: Hexagonal. *Point Group*: 6/*m* 2/*m* 2/*m* or $\bar{3}$ 2/*m*. As minute hexagonal crystals, elongated along [0001] to 0.2 mm. 3*R* polytype shows octahedral or hexagonal pyramidal and prismatic forms.

Physical Properties: *Cleavage*: Perfect on {0001}. *Tenacity*: n.d. *Fracture*: n.d.
Hardness = n.d. D(meas.) = n.d. D(calc.) = 2.82

Optical Properties: Transparent to milky. *Color*: White to pale yellow. *Streak*: White.
Luster: Subvitreous to adamantine.
Optical Class: Uniaxial (-). Very high interference colors in thin section.

Cell Data: *Space Group*: $R\bar{3}\,m$. a = 3.06616(1) c = 22.6164(1) Z = 3 3*R* polytype
$P6_3/mmc$. a = 3.0725(3) c = 15.114(4) 2*H* polytype

X-ray Powder Pattern: Calagio quarry, Colonnata valley, Apuan Alps, Italy. 2*H* polytype
7.51 (vs), 1.542 (ms), 1.539 (ms), 3.794 (m), 2.511 (mw), 2.175 (mw), 1.830 (mw)

Chemistry:

	(1)
CuO	0.24
ZnO	56.01
Al_2O_3	18.44
SiO_2	0.09
Total	74.78

(1) Calagio quarry, Colonnata valley, Apuan Alps, Italy; average electron microprobe analysis, CO_3 and H_2O confirmed; corresponds to $[(Zn_{3.92}Cu_{0.02}Al_{2.06})(OH)_{12}][(CO_3)\cdot 3H_2O]$. (2) El Soplao cave, northern Spain; average electron microprobe analysis, H_2O and CO_3 groups confirmed by TGA, mass spectroscopy, and FTIR spectroscopy; corresponds to $(Zn_{3.0}Al_{2.0})(OH)_{10}(CO_3)_{1.0}\cdot 2.5H_2O$.

Polymorphism & Series: 2*H* and 3*R* polytypes.

Mineral Group: Hydrotalcite-manasseite family.

Occurrence: In cavities in calcite veins in marble formed through alteration of sphalerite by aluminum-rich hydrothermal fluids (Italy). By diagenesis of Zn- and Al-rich ferromanganese speleo-stromatolites (Spain).

Association: Hydrozincite, fraipontite (Italy).

Distribution: From the Calagio quarry, Colonnata valley, Apuan Alps, Italy. At El Soplao cave, northern Spain.

Name: Honors scholar Domenico *Zaccagna* (1851-1940), who published the first geological map of the Apuan Alps and was a competent collector of minerals from the Carrara marble.

Type Material: Natural History Museum, University of Pisa, Italy.

References: (1) Merlino, S. and P. Orlandi (2001) Carraraite and zaccagnaite, two new minerals from the Carrara marble quarries: their chemical compositions, physical proprieties, and structural features. Amer. Mineral., 86, 1293-1301. (3) Lozano, R.P., C. Rossi, Á. La Iglesia, and E. Matesanz (2012) Zaccagnaite-3*R*, a new Zn-Al hydrotalcite polytype from El Soplao cave (Cantabria, Spain). Amer. Mineral., 97, 513-523.