Holtedahlite $Mg_{12}(PO_4)_5(PO_3OH, CO_3)(OH, O)_6$

Crystal Data: Hexagonal. *Point Group:* $3m$. Massive, in patches to 1 cm.

Physical Properties: *Fracture:* Uneven. Hardness = 4.5–5 D(meas.) = 2.94(2) D(calc.) = 2.936

Optical Properties: Transparent. *Color:* Colorless, grayish from inclusions of magnetite. *Luster:* Vitreous.
Optical Class: Uniaxial (–). $\omega = 1.599(1)$ $\epsilon = 1.597(1)$

Cell Data: *Space Group:* $P31m$. $a = 11.203(3)$ $c = 4.977(1)$ $Z = 1$

X-ray Powder Pattern: Tingelstadtjern quarry, Norway.
2.438 (100), 3.722 (90), 3.475 (50), 3.234 (30), 2.796 (30), 2.177 (30), 1.859 (30)

Chemistry:

	(1)
P_2O_5	41.19
CO_2	2.06
MnO	0.06
MgO	50.01
Na_2O	0.22
F	0.34
H_2O	6.22
$-O = F_2$	0.14
Total	99.96

(1) Tingelstadtjern quarry, Norway; by electron microprobe, $(OH)^{1-}$, CO_2, and PO_4 confirmed by IR and elemental analyser; corresponds to $(Mg_{11.84}Na_{0.07})_{\Sigma=11.91}(PO_4)_5[(PO_3OH)_{0.54}(CO_3)_{0.44}]_{\Sigma=0.98}[(OH)_{5.83}F_{0.17}]_{\Sigma=6.00}$.

Polymorphism & Series: Dimorphous with althausite.

Occurrence: In a serpentine–magnesite deposit (Tingelstadtjern quarry, Norway); a common accessory mineral, of likely pneumatolytic origin, in an igneous magnetite–apatite deposit (Gole Gohar, Iran).

Association: Althausite, szaibelyite, apatite, talc, magnetite, magnesite (Tingelstadtjern quarry, Norway).

Distribution: From the Tingelstadtjern quarry, Modum, Norway. Into the millions of tons at the Gole Gohar iron deposit, Bafq district, Iran.

Name: Honors Olaf Holtedahl (1885–1975), Professor of Geology, University of Oslo, Oslo, Norway.

Type Material: Mineralogical-Geological Museum, University of Oslo, Oslo, Norway; National Museum of Natural History, Washington, D.C., USA, 128674.

References: (1) Raade, G. and M.H. Mladeck (1979) Holtedahlite, a new magnesium phosphate from Modum, Norway. Lithos, 12, 283–287. (2) (1980) Amer. Mineral., 65, 809–810 (abs. ref. 1). (3) Rømming, C. and G. Raade (1989) The crystal structure of natural and synthetic holtedahlite. Mineral. Petrol., 40, 91–100. (4) Raade, G. (1990) Hydrothermal syntheses of $Mg_2(PO_4)OH$ polymorphs. Neues Jahrb. Mineral., Monatsh., 289–300. (5) Mücke, A. and R. Younessi (1994) Magnetite-apatite deposits (Kiruna-type) along the Sanandaj-Sirjan zone in the Bafq area, Iran, associated with ultramafic and calcalkaline rocks and carbonatites. Mineral. Petrol., 50, 219–244.