

# Ferrowyllieite $(\text{Na, Ca, Mn}^{2+})_2(\text{Fe}^{2+}, \text{Mn}^{2+})(\text{Fe}^{2+}, \text{Fe}^{3+}, \text{Mg})\text{Al}(\text{PO}_4)_3$

©2001-2005 Mineral Data Publishing, version 1

**Crystal Data:** Monoclinic. *Point Group:*  $2/m$ . Crude euhedral crystals, to 10 cm, in interlocking aggregates; rimming arrojadite.

**Physical Properties:** *Cleavage:* On  $\{010\}$ , perfect; on  $\{\bar{1}01\}$ , distinct. *Tenacity:* Very brittle. Hardness =  $> 4$  D(meas.) = 3.601(3) D(calc.) = 3.60

**Optical Properties:** Transparent to opaque. *Color:* Deep bluish green, oily green, grayish green, greenish black; pale green in transmitted light. *Streak:* Dirty olive-green. *Luster:* Oily to submetallic.

*Optical Class:* Biaxial (+). *Pleochroism:* Observable in thick plates;  $X$  = smoky bluish gray;  $Y$  = smoky bluish green;  $Z$  = green. *Dispersion:*  $r < v$ , strong. *Absorption:*  $Z > Y \simeq X$ .  $\alpha = 1.688(2)$   $\beta = 1.691(2)$   $\gamma = 1.696(2)$   $2V(\text{meas.}) = \sim 50^\circ$

**Cell Data:** *Space Group:*  $P2_1/n$ .  $a = 11.868(15)$   $b = 12.382(12)$   $c = 6.354(9)$   
 $\beta = 114.52(8)^\circ$   $Z = 4$

**X-ray Powder Pattern:** Victory mine, South Dakota, USA.  
2.693 (10), 2.674 (10), 6.15 (6), 3.449 (5), 2.498 (5), 8.12 (4), 3.047 (4)

Chemistry:	(1)	(2)	(1)	(2)	
$\text{P}_2\text{O}_5$	43.8	44.6	MgO	1.97	4.8
$\text{SiO}_2$	0.8	0.1	CaO	2.5	0.95
$\text{Al}_2\text{O}_3$	7.9	7.1	$\text{Li}_2\text{O}$	0.01	0.01
$\text{Fe}_2\text{O}_3$	0.33	4.8	$\text{Na}_2\text{O}$	8.0	7.1
FeO	29.2	20.2	$\text{K}_2\text{O}$	0.05	0.00
MnO	4.3	9.6	$\text{H}_2\text{O}^+$	0.70	0.60
ZnO	0.04	0.08			
			Total	99.6	99.94

(1) Victory mine, South Dakota, USA;  $\text{H}_2\text{O}$  by calorimetry, corresponds to  $(\text{Na}_{1.25}\text{Mn}_{0.30}^{2+}\text{Ca}_{0.22}\text{Fe}_{0.01}^{2+})_{\Sigma=1.78}\text{Fe}_{1.00}^{2+}(\text{Fe}_{0.96}^{2+}\text{Li}_{0.03}\text{Mg}_{0.01})_{\Sigma=1.00}(\text{Al}_{0.75}\text{Mg}_{0.23}\text{Fe}_{0.02}^{3+})_{\Sigma=1.00}(\text{PO}_4)_3$ . (2) G.E. Smith mine, New Hampshire, USA; corresponds to  $(\text{Na}_{1.07}\text{Mn}_{0.43}^{2+}\text{Ca}_{0.08})_{\Sigma=1.58}(\text{Fe}_{0.84}^{2+}\text{Mn}_{0.16}^{2+})_{\Sigma=1.00}(\text{Fe}_{0.48}^{2+}\text{Mg}_{0.48}\text{Li}_{0.03})_{\Sigma=0.99}(\text{Al}_{0.65}\text{Fe}_{0.28}^{3+}\text{Mg}_{0.07})_{\Sigma=1.00}(\text{PO}_4)_3$ .

**Polymorphism & Series:** Forms two series, with wyllieite, and with rosemaryite;  $\text{Fe}^{2+} > \text{Mn}^{2+}$  in M(1);  $\text{Fe}^{2+}$  dominant in M(2a).

**Occurrence:** A primary phosphate in zoned granite pegmatites.

**Association:** Arrojadite, muscovite, schorl, plagioclase, quartz (Victory mine, South Dakota, USA).

**Distribution:** In the USA, from the Victory mine, four km northeast of Custer, Custer Co., South Dakota, and at the G.E. Smith mine, Newport, Sullivan Co., New Hampshire.

**Name:** As a mineral with dominant *ferrous* iron, and its relation to *wyllieite*.

**Type Material:** National Museum of Natural History, Washington, D.C., USA, 126318, 137244, 162555, 162556.

**References:** (1) Moore, P.B. and J. Ito (1973) Wyllieite,  $\text{Na}_2\text{Fe}_2^{2+}\text{Al}(\text{PO}_4)_3$ , a new species. Mineral. Record, 4, 131–136 [redefined to be ferrowyllieite]. (2) Moore, P.B. and J. Molin-Case (1974) Contribution to pegmatite phosphate giant crystal paragenesis: II. The crystal chemistry of wyllieite [= ferrowyllieite],  $\text{Na}_2\text{Fe}_2^{2+}\text{Al}[\text{PO}_4]_3$ , a primary phase. Amer. Mineral., 59, 280–290. (3) Moore, P.B. and J. Ito (1979) Alluaudites, wyllieites, arrojadites: crystal chemistry and nomenclature. Mineral. Mag., 43, 227–235. (4) (1980) Amer. Mineral., 65, 810–811 (abs. ref. 3).

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise without the prior written permission of Mineral Data Publishing.